TRAFFIC QUARTERLY

AN INDEPENDENT JOURNAL FOR BETTER TRAFFIC

JULY 1953

'Drivers'
Fringe Parking
Chicago's Parking Program
Buffalo's Truck Route System
Highway Design in Roadside Control
Land Planning and Traffic Engineering
Industrial Traffic in Rural Areas
Expressways and Civic Planning
New York's Rural Expressways
Intersection Design Factors
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THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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Editorial

INCREASED national interest in ways to improve public driving and fix responsibility for it is a highly commendable attitude—and long overdue. So is nationwide concern for the need to attain both goals. The delay has aggravated the problem, but it also has afforded the opportunity to learn more about it.

All our well-meaning should not lead us into precipitate and indiscriminate measures. Our exhausted patience with deplorable traffic conditions should not incite us to impracticable action.

No proposals for a solution of the problem should be made without a full and complete understanding of its underlying causes. No measures should be proposed that have as a basis the condemnation of all drivers. Yet no measures can be too severe for wilfully bad drivers.

Safety on the roads can result only from good driving, and such safety that we have is the good drivers' contribution. Under whatever circumstances you obtained your original permit to drive, your driving record should determine your competence for continued retention of it.

Driving records should be distinct from financial responsibility. Financial responsibility should not temper concern or consideration for faults or consequences of bad driving that are a part of a driving record.

A principal part of the problem seems to be that we are unwilling to insist that poor drivers drive as competently as the average good ones, and that poor driving will not be tolerated. Our past submissive attitude is difficult to defend.

If we prescribe suitable standards and proceed statistically on the basis of driving records, it is not difficult to determine who are the poor drivers. To a considerable degree their records are conclusive. We have not recognized, nor have we been as proficient in keeping, the records of the good ones. This condition has arisen from our tolerance of incompetence and lack of purposeful requirements. It has resulted in a lack of respect for measures presumed adequate.

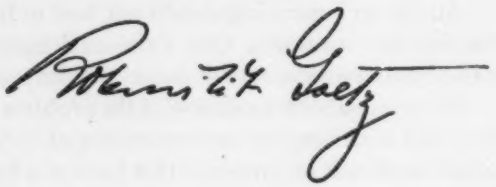
Nearly half our population drives. It assuredly would be in-

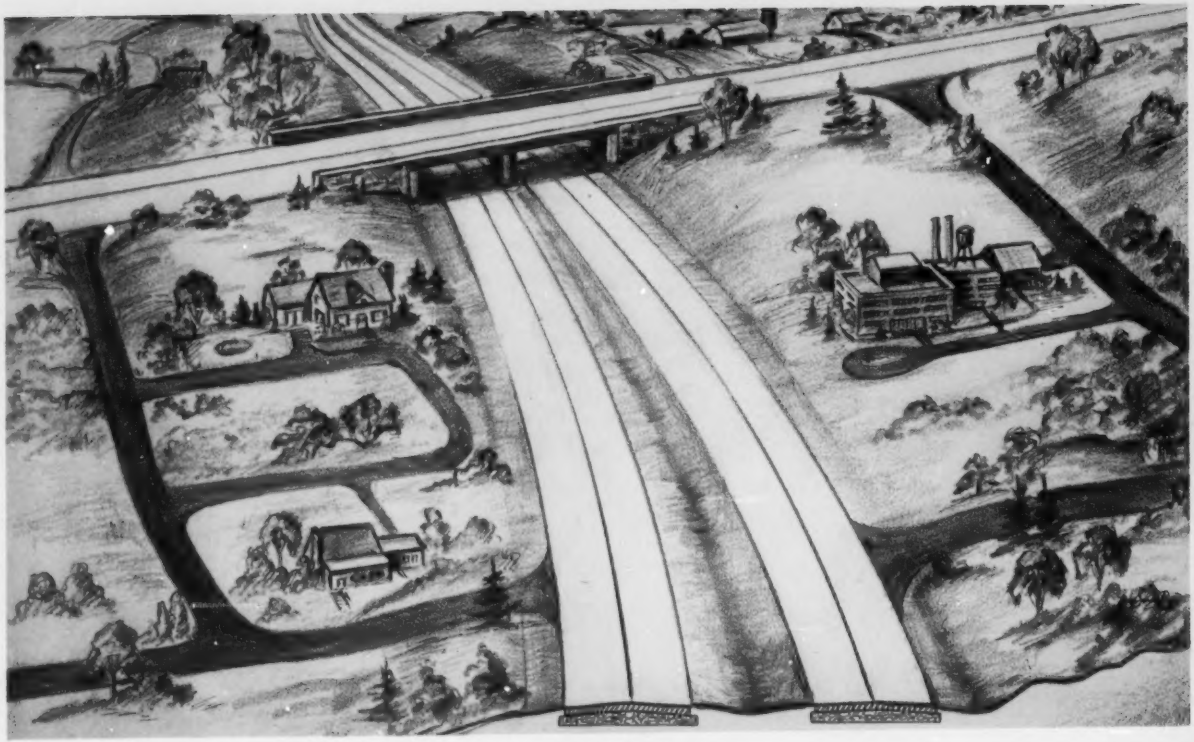
tolerable to impose any measures that would breed annoyance, irritation, or lead to practices of unfairness and corruption.

Good drivers should not be plagued with nuisance measures. On the contrary they should be rewarded.

Drivers proved bad should be viewed only as bad drivers. They should be provided with the opportunity to improve. If incorrigible, they should not be permitted to drive.

There is no place on the road for bad drivers.





Typical New York State Expressway.

The Development of Expressways in New York State

B. D. TALLAMY

Mr. Tallamy is New York State Superintendent of Public Works and Chairman of the Thruway Authority. He has direct charge of all public works construction in the Empire State, including the New York State Thruway, which will be the world's longest, most modern express highway. Since 1925, Mr. Tallamy, a Civil Engineer, has engaged in construction and engineering work, including private and public housing projects, waterworks, dams, bridges, and highways. In January, 1945 Mr. Tallamy resigned as chief engineer of the Niagara Frontier Planning Board and withdrew from his private engineering firm to accept appointment as deputy superintendent of Public Works of the State of New York. He was promoted to Chief Engineer on July 1, 1947, and was appointed Superintendent on October 1, 1948. He is a member of the American Society of Civil Engineers, the Society of American Military Engineers and the National Society of Professional Engineers. He has been first vice president and president of the American Association of State Highway Officials.

TREATED in proper relationship to the whole family of traffic facilities, expressways become powerful weapons in the battle against traffic congestion. Without comprehensive planning, the most skillfully designed expressway becomes only the quickest route between two bottlenecks. Or, to put it in another way, a highway system is only as strong as its weakest links.

In New York State our approach to expressway development has been to treat these high capacity traffic arteries as vital parts of road systems rather than as individual routes. We are building four types of expressways in New York State: rural, parkways, urban arterials, and the Thruway. The illustration shows a cross section which is characteristic of all these types except the Thruway, where access points are limited to interchanges.

Any discussion of expressway development in the Empire State must concern itself largely with the Thruway, which holds the

solution to many of our most pressing traffic problems. A key to future expressway development as well as to the better highway system we so urgently need, the Thruway is being accorded a high priority in the construction program. Historically, however, the Thruway is a late comer in the expressway field.

Rural Expressways Prove Their Worth

Rural expressways represent a big step forward in our transportation network. Since 1937, when the Legislature implemented our highway program with authority to build limited access highways, New York State has built twenty-five miles of rural expressways and has an additional thirty-two miles underway. These roads are designed to standards approaching the ultimate in safety, traffic capacity, and comfort.

The minimum facility consists of two 24-foot roadways separated by a variable median with minimum eight-foot shoulders. Grades are a maximum of 4 percent, aiding efficient heavy truck operation. Safety is built in by minimums of 800 feet for sight distances and a 2,000 foot radius for curves. We believe that our rural expressways offer the traveling public as safe and convenient transportation as we can furnish for the money outlay. Access points are carefully located to insure the maximum utility both of the expressway and connecting roads; expressways, after all, are primarily functional.

These roads are proving their worth. For example, during July, 1952, the Goshen-Fair Oaks highway in southern New York carried an average daily traffic of 13,260 vehicles; the annual daily average on this route is 6,100, fairly high for a rural route bypassing Middletown, a city of nearly 23,000. The relief to the existing road system serving Middletown is considerable.

At present rates of traffic expansion, the Goshen-Fair Oaks expressway will be adequate for many years, and we will avoid expensive reconstruction on the existing route. Based on curves plotted from our Department's continuous counter records, a design hour is being used that usually falls in the range from the 30th to the 50th highest hour.

However, we have only made a start at developing rural expressways in New York State. On January 1st, 1952, the state highway system outside of cities totaled 14,354 miles of roads, including 1,404 miles unimproved. This represented an increase of some 11,000 miles since the first official system was established in 1908. Recently, the State's transportation network has been classified into five systems on the basis of traffic service, the heaviest traffic volumes naturally occurring on those routes which connect the large cities and other important activity centers. These heavily traveled routes comprise our interstate and inter-regional system and our intercity system, both of which are important enough in the State traffic network to warrant expressway design on a substantial portion of the whole mileage. The magnitude of the task is best realized by the system figures. There are 1,780 miles on the interstate and inter-regional system and 3,650 miles on the intercity system.

Thus the current forty-two miles of controlled access routes meet only a small fraction of our needs. This mileage, incidentally, is virtually all on Route N.Y. 17, an inter-regional route linking New York City and southern New York State with the Midwest and West, via interstate route U.S. 20. An additional 208 miles of divided highways exist on the state system, but these are not true expressways. Due to lack of access control, the efficiency of these routes is gradually being reduced. New York State, as elsewhere, must face the prospect that before too many years have passed roadside commercial and residential development will make these non-controlled divided highways inadequate for high-speed, high-volume traffic arteries. It is inescapable that only the expressway will have full utility ten, twenty-five and more years hence.

Parkways Prohibit Commercial Traffic

Parkways make a brighter picture. There are 466 miles of parkways in the State, and by conservation law as well as specific restrictions in land takings, all of our parkways are built with full control of access. Commercial traffic, of course, is prohibited on all State parkways.

There is no fixed standard for design of New York State parkways. Since these routes are primarily planned to offer the traveler

convenient through-facilities and a superb opportunity to enjoy the scenic beauties of the State, rather than to serve as high-speed, mixed-traffic facilities, design standards vary considerably from parkway to parkway or even on sections of the same parkway. Design standards are not intended to meet minimums for rural expressways.

Whereas divided sections of parkways are now designed for a minimum width of two twenty-four-foot pavements, sight distances are less than those on rural expressways and grades are generally steeper. Sharper curves, also, limit the driving speed on parkways: this type of design is planned both to discourage speeding and to encourage a leisurely appreciation of the surrounding countryside. The mountable curb is used extensively to permit emergency stops for disabled vehicles.

Although State parkways are not included in the official State highway system mileage, they serve as important adjuncts to the transportation network. Besides offering fine facilities for recreational traffic, parkways serve as auxiliary through-routes connecting our larger cities with other important destination points. When built for this purpose the design standards more nearly approach those of rural expressways.

Outstanding examples of our parkway system are the routes connecting New York City to Long Island, to upstate New York, and to New England; the parkways in the Niagara Frontier area, and the Rochester area parkways. Their traffic figures are fantastic: for example, volumes averaged as high as 60,000 vehicles daily on Sawmill River Parkway during the month of July, 1952; the average daily traffic was 46,502. These tremendous volumes, of course, are only possible because of the lower operating speeds on parkways. In the New York City area, parkways are usually loaded to practical capacity, and on holiday weekends, to ultimate capacity. Upstate sections of the parkway system, however, will still be adequate for increased traffic loads for the next twenty years.

System Linked by Urban Expressways

In 1944, the Legislature extended the highway system into all New York State cities, except Sherrill, a central New York community of

Section of New York Thruway near Buffalo.

Scenic Taconic Parkway.

A Rural Expressway.

Aerial Photography by Skyviews

Brooklyn-Queens Expressway—from Williamsburg Bridge Plaza in Brooklyn to Queens; reconstructed recreation areas shown in Williamsburg Bridge Plaza.

2,336 population, which is a city only for local administrative purposes. This legislation brought into focus the place of the urban street system in the statewide transportation network, stating as a declaration of policy "... The resources and skills that are available to the state for these purposes, should be used for the benefit of the cities upon the principle that the construction of such arterial highways is a matter of state concern ..." New York City arterial routes, although they constitute a part of the State highway system, were the subject of special treatment in the legislation.

To accomplish the objectives defined by the Legislature, the Department established a Bureau of Arterial Route Planning in 1946. In 1949 the scope of the work was broadened and the Bureau of Highway Planning was set up. This agency serves as the main office for all highway planning in New York State, with separate units for rural and urban planning and a unit for vehicle operation and research. Each of our ten Public Works District Offices also carries on highway planning, with coordination and supervision by the main office.

The urban arterial program is well underway. Including New York City, which has prepared its own system plan, forty cities have received urban area reports covering 495 miles of arterial routes. Up to January 1st, 1952, we had built 146 miles of urban expressways, with an additional 34 miles underway. There were, in addition to these urban expressways, 20 miles of divided highways in the State's sixty-one cities; but these, like the rural divided highways, operate at reduced efficiency due to marginal traffic conflicts.

The problem of access control is of course intensified in cities where close-knit gridiron streets serve the population areas and sections devoted to commerce and industry, and new location suitable for urban expressways is next to impossible to find. Although these considerations often prevent true expressway design, we have been fairly successful in minimizing traffic conflicts by strategically locating arterials, especially divided highways, adjacent to natural barriers to cross traffic. Many of our urban arterials, therefore, approach expressways in utility, despite lack of legal control of access. The extra effort expended in exhaustive route location studies yields very good dividends.

Our urban expressways, like our parkways, are varied in design. Alignment and grade are often controlled by property values and land use. Then too, the characteristically slower speeds of city travel do not justify the expense of constructing to the standards of the high speed rural expressways. We do hold to a minimum pavement width of two 24-foot roadways, and the usual section has a curb of the non-mountable type. Access is permitted only at major traffic interchange points.

Our urban expressways are vital links in both urban and rural highway systems. In relation to the city street system, the urban expressway is the main artery, collecting and distributing traffic at selected points where important volumes of traffic desire to enter or leave. In larger cities, the expressway is absolutely indispensable to the orderly flow of traffic. Our first efforts toward urban traffic relief, therefore, have been devoted to New York City, Buffalo, Rochester, and Syracuse.

From 60 to 90 percent of the traffic entering a city, depending on its size, is destined for the city. The expressway takes this State highway traffic safely and quickly to the desired interchange points, where local traffic distributors pick up the traffic stream. Through-traffic is not subjected to local interference. Thus if we think of our State highway system as a chain broken by cities, the urban expressways are the connecting links which weld the whole system into a continuous network.

The Thruway Crosses Entire State

In 1942 the Legislature authorized the most comprehensive expressway system ever conceived in the United States. This system—the New York State Thruway—complements the State highway, parkway, and urban systems, giving motorists the unparalleled opportunity of crossing the entire State safely and swiftly without interference from cross traffic or urban traffic.

This ultramodern expressway is the responsibility of the Thruway Authority, an agency established in 1950 to plan, construct and reconstruct, operate, and maintain the new facility. The Authority is autonomous, with a chairman and two other members composing

the board. When completed, the Thruway will operate on a special permit and toll basis.

Considerably more than 500 miles of expressway are planned for ultimate development in the Thruway system. To date, a total of 55 miles are completed and operating as a supplemental free facility for State highway traffic; the remainder of the 427 miles between New York City and Buffalo are under construction. The design represents the most advanced thinking not only for our Department, but also of highway engineers throughout the country.

Minimum pavement width is two 25-foot lanes, with provision for an additional 12-foot lane on each side. The width of the median is a minimum of 20 feet and is being varied to avoid monotony. Shoulder width is a minimum of nine feet. Grades are held to a 3 percent maximum, and horizontal curves will have a minimum radius of 2,800 feet. Both horizontal and vertical sight distances are at least 1,000 feet. By landscaping, the route will be made attractive to view and headlight glare will be minimized. Wherever practicable, opposing lanes will be constructed at different elevations to further minimize headlight glare and to avoid monotony. Access, of course, will be fully controlled throughout the route, and adjacent advertising displays will be regulated. Gasoline stations, restaurants, and snackbars will be provided at convenient locations.

The Thruway will play a vital role in the overall transportation network. In relation to the rural highway system, the addition of this expressway will relieve presently overcrowded highways and reduce the cost of constructing parallel routes. Since the Thruway is planned and constructed within new right-of-way, there will be no appreciable disruption of existing land use.

Similarly, the Thruway will bring direct traffic relief to the urban highway system of twenty-one cities. Also, each of these will be brought closer, in time if not in space, to all other cities served by the Thruway, since integration of its location design with urban arterial plans will expedite traffic movements destined to these cities. Cities not directly served by the Thruway will also have some measure of traffic relief due to diversion of traffic; motorists have consistently shown a willingness to travel a little farther for the sake of comfort, convenience and safety.

Programming the Transportation Network

Planning New York State highways has been only the first skirmish in the battle against traffic congestion. Highway programming has received equally intensive study. We have set up a ten-year program for every type of road system in the State, from the town roads that serve outlying farms and dwellings to the complex network of New York City expressways. As in the planning, the programming of the transportation network has been comprehensive. We have not thought it necessary at this stage to set up any separate program for expressways.

In 1948–49 we conducted a complete study of the State's highway needs. From this study we established indices which indicated the extent of deficiency in the various categories of road utility. To keep abreast of changes in our road systems, we have set up a five-year reinventory schedule, and 20 percent of the State system was resurveyed during 1952.

Based on indices of needs, we set up two programs for highway improvement. The first, a three-year program, was intended only as a stopgap measure and has been considered as such. This program gave us a chance to catch our breath. Construction proceeded along a plan based on statewide needs; meanwhile, we were reinventorying a part of the State system, studying the urban, town, county, and other road systems, and laying the groundwork for a comprehensive ten-year program.

As previously stated, rural expressways are not treated as individual problems. These facilities are programmed as elements of the overall road system. When our ten-year program calls for reconstruction of a route on the interstate and inter-regional or intercity systems, every effort is made to relocate the route on new location where we can take land subject to control of access. Naturally, each project is studied for economic justification and maximum benefits to existing land use. In that respect, and that respect only, our rural expressways are treated as individual problems.

Programming for urban expressways has followed a different pattern from that of rural programming. Because of the magnitude of the New York City traffic problem, we have set up a separate con-

struction schedule for the arterial routes serving the metropolitan area. This ten-year program is only a beginning, based on available plans and financing; the expressway system in New York City has no hard and fast limits. In a city of 8,000,000, traffic needs just can't be measured in the conventional manner. As fast as we can build New York City expressways they become filled; there is always a backlog of demand.

Upstate urban expressways, however, are programmed somewhat like their country cousins. The immediate need of course is for arterial routes in the larger cities, which in proportion to their population are as badly off as New York City. Our urban program follows this order: first, the important urban links in interstate and interregional and intercity systems (this category naturally includes the arterials in our large cities); second, the same type of route in smaller cities; third, the local arterials, or connectors of less important State routes serving our larger cities; fourth, the local arterials in smaller cities. It is obvious that the first type of arterial warrants expressway design; and we do our best to get it.

Programming the Thruway is one of the functions of the Thruway Authority, created by legislative act in March 1950. Although the project had been started on a piecemeal basis several years earlier, the Authority took over the entire program, coordinated the design and construction and let contracts at an unprecedented pace. As a result, the entire 427-mile main route from New York City to Buffalo is scheduled to be opened to traffic late in 1954. Such an accomplishment would be impossible, of course, had not a special agency been created to do the job.

Financing Expressway Construction

We finance expressway construction in New York State just as we plan and program expressways—as part of our regular procedure. All construction, reconstruction, and maintenance on the State traffic network is done by allocations from the State's General Fund. Each year the Department of Public Works, like all New York State departments of government, prepares its budget for the guidance of the Governor in submitting the State budget to the legislature.

Two other sources of money finance our highways and expressways. The Federal-Aid program, on a matching basis, helps finance our rural highway program. In our cities, Federal participation in the arterial program is likewise on a matching basis, but the cities also participate to the extent of 50 percent of right-of-way costs.

The whole problem of financing our road system has become so critical and complex that New York State has decided to meet the issue head-on. In 1952, the Legislature authorized a thirteen-member body known as the Temporary Highway Finance Planning Commission "... (a) to conduct a study and survey of methods of financing the cost of highway construction and maintenance; (b) to make recommendations for the development of additional sources of general fund revenues; and (c) to formulate a comprehensive, long range program for financing the rehabilitation, improvement and development of the highway system of this state...." We presented the commission with the latest information on our highway-needs studies and the ten-year programs based on these needs; and we expect that the commission studies will result in a practical approach to highway financing in New York State.

The Thruway financing method represents something of a new departure in this field. The Authority is empowered to issue up to $500,000,000 in bonds or other obligations to complete the project. Because these bonds could be sold at a much lower interest rate if they were guaranteed by the State of New York, a constitutional amendment to permit the State guarantee was initiated in the 1950 Legislature. Passed by that Legislature and again in 1951, the amendment was approved by the voters in November, 1951, by a margin of four to one. The effect of the amendment will be to reduce Thruway financing costs by well over $100,000,000 during the life of the bonds.

Public Relations Promotes Acceptance

Like other worthwhile public projects, expressways have to be described fully to the public. Emphasis, however, has not been on expressways in particular, but on the traffic network in general in promoting public interest in the State's highway program.

Formal presentation of urban area arterial reports to city and county officials has focused much attention and promoted widespread interest in urban traffic problems. We usually have large turnouts of civic groups, businessmen, and other interested parties at presentations. Prior to formal presentation, we issue publicity releases to newspapers all over the State. Local newspapers, naturally, play up the stories prominently. Besides formal press releases, we conduct press conferences in each affected city several days prior to the presentation. We sometimes hold informal meetings with citizens' groups after the report presentation.

The high percentage of city arterial plan acceptances indicates that we are on the right track. The first step in solving a problem is to define it carefully and then with equal care to develop its solution. That we do, reducing it to the simplest terms for better understanding by the general public. They usually accept the challenge.

Expressways of the Future

Highways in general, but expressways in particular, challenge our imagination. What will the expressway of the future be? The answer lies in design. What will be the future of the expressway? This answer lies in planning, programming, and financing—in the whole field of Department policy.

We anticipate that future urban expressway design will be substantially the same as at present. Our sights are set on completion of 77 percent of the primary urban arterial routes within the next ten years. Included in this figure are all the urban expressways that will be needed for local traffic relief and completion of the important statewide network. The remaining 23 percent of our primary urban routes will have to be deferred beyond the ten-year period, as will supplemental urban plans. These supplemental plans afford the best guess for needs beyond a fifteen-year forecast period. However, we need to assemble much more factual data before we can advance these plans to the report presentation stage.

The rural expressway is just coming into its own. The most telling argument for this type of facility is an expensively constructed highway suffering from roadside development blight. We are going

to make the rural expressway the ultimate foundation of our official state highway system.

Rural expressways have just crossed the threshhold of a vast new era of importance to state and national welfare. They will soon become the foundation of our intercity and regional transportation. They will become the arteries which feed the state highway system and through it the county and town systems. Ultimately we hope to make rural expressways of New York State the backbone of our whole highway network. They hold the key to the future of motor vehicle transportation. They can lead to new and limitless horizons of social and economic opportunities. But they cannot do it alone. They are only a part of the whole great highway facility, all members of which must continue to grow if we are to reach the ultimate benefits the coming era of highway transportation can afford. That should be our goal.

The Industrial and Public Traffic in Our Rural Areas

D. M. McCRACKEN AND C. A. GOODWIN

Mr. McCracken is assistant vice president and motor transport bureau manager, Liberty Mutual Insurance Company, Boston, Massachusetts. He received a Master's degree at the Harvard University Bureau of Street Traffic Research. From 1931 to 1933, he served in various traffic engineering capacities with the Massachusetts Department of Public Works, and spent two years as traffic auditing engineer of Southern California territory for the Traffic Audit Bureau, Inc. Mr. McCracken began his career with Liberty Mutual Insurance Company, as highway safety supervisor, Engineering Department from 1935–40; he was director, Traffic Safety Bureau, 1940–45, and since then, manager of the Motor Transport Bureau. He was made an assistant vice president in May, 1949.

Since 1948, Mr. Goodwin has been traffic and transportation engineer, Liberty Mutual Insurance Company, in Boston. He attended the Yale Bureau of Highway Traffic as an Automotive Safety Foundation Fellow 1948–49. From 1940–1947, Mr. Goodwin served as transitman and assistant grade crossing engineer, Maintenance of Way Department of the Boston and Maine Railroad.

THE advantages and disadvantages of large city decentralization have long been seriously considered by city planners, business leaders and traffic engineers. This article impartially discusses the effect of industrial and commercial decentralization upon the traffic and transportation systems of communities in the 50,000 and under population group, with particular emphasis on the industrial aspect.

It is necessary, for purposes of this discussion, to acknowledge the reality and scope of the decentralization trend. This implies recognition also of the special traffic problems that result from a concentration of manpower and vehicles which necessarily follows the development of a plant, the development of a shopping center or other "generator" in, or immediately adjacent to, the smaller communities.

Development of Commercial Decentralization

Much has been written about the traffic designs, facilities and controls created when department stores, motor truck terminals, theaters, food markets, and other establishments join the trek "to the country." While many of these commercial units have been combined into "shopping centers," a considerable amount of independent site selection remains within the smaller communities.

Large New York department stores, for example, have built elaborate branches in Hempstead, Eastchester, New Rochelle, and other interlocked villages and towns. Drive-in theaters now represent a huge dollar business and thousands of installations are serving millions of patrons. Super-markets develop in grandiose fashion adjacent to major arterial interchanges. To meet the "at-the-door" service demands of commercial centers and industrial plants, motor carriers have established way-terminals to expedite the delivery, pickup and transfer of goods. Considerable reference material is available on commercial decentralization, including the economic, architectural, engineering and public relations factors involved. Not enough attention however, has been given to the traffic ramifications arising from industrial decentralization.

Trend Toward Industrial Decentralization

The combination of World War II, postwar domestic commodity demand, and the current defense effort, created an accelerated production schedule for both heavy and light manufacture, often overburdening production facilities. Large industrial concerns divided their manufacturing processes into production parts, each part separated geographically in subsidiary plants for subassembly or manufacture of component units. These subsidiary plants were built in the greatest available land area to permit horizontal layouts, thereby eliminating multi-floor operations and expediting the flow of materials in process. Thus the roads of outlying communities became conveyor belts in the overall production system.

Smaller independent manufacturers, awarded large contracts, were enabled to expand their facilities rapidly. Because of space

limitations at their existing site, they sought and obtained available tracts of undeveloped land on the periphery of their communities, and erected new plants capable of handling increased production demands.

In addition to new plant construction, the majority of the plants built by the Defense Plant Corporation during World War II and abandoned after the conflict, have been purchased and re-opened by the occupants.

The important point, with regard to the creation of subsidiary plants and new industries, is their location. For the most part, the site chosen is closely related to land valuation, size requirements, proximity to access highways, availability of manpower, raw material sources and production methods.

To a large degree, all these factors of site selection are most satisfactorily combined, not in the congested urban areas, but in quasi-rural areas generally representative of townships and outlying residential sub-divisions. The catalytic agent, which permits the easiest and most practical combination of site selection factors is of course the *motor vehicle.* The flexibility provided by highways in the transportation and accessibility of materials and manpower, has eliminated the need for plant development in urban areas where manpower and rail facilities are heavily concentrated.

While these basic factors of plant site selection hold generally, there are other equally important reasons for establishing industrial plants in semi-isolated areas. These are best illustrated by a few examples:

1. *Aircraft Manufacture:* This industry has decentralized to areas less vulnerable to air attack and where special facilities can be constructed for test flight operations.

2. *Automobile:* Assembly line units in widely separated areas permit a more balanced, efficient market distribution geographically.

3. *Textiles:* A substantial movement has been made by this industry to areas with cheap and abundant power sources and labor, preferably near raw material sources.

4. *Food Processing:* This extensive process, including canning, freezing and/or packaging is controlled by the location and harvesting schedule of crops. The operation is therefore periodic or sea-

sonal, but of sufficient duration and size to create heavy labor and transportation concentrations.

5. *Bottling:* The clean, showroom method followed in the bottling of beverage products, lends itself to pleasant, rustic surroundings, commonly found adjacent to parkways.

6. *Research-Electronic, Chemical and Other:* The quiet, restricted nature of special research requires that laboratories and other buildings be secluded.

A Transfer of Traffic Congestion

As an outgrowth of the industrial decentralization trend, not a few of the traffic evils identified with concentrated urban centers, have shifted with industry. These are now manifested particularly in those areas most immediately subjected to the pressure of mass movements by employee and service vehicles.

The peculiar receiving and shipping needs of industrial interests lie somewhere between those of the urban business concern and the private motor carrier. With industry dependent more and more upon commercial vehicle services to transport vital raw materials and finished products, an additional traffic load is imposed on access roadways that may or may not pass through community centers. The movement of heavy commercial vehicles presents a problem only when it interferes with the movement of other traffic units through violation of traffic regulations, misuse of available roadway space, or other operational inefficiencies incurred in servicing industrial plants.

When the movement of commercial vehicles, employee vehicles, pedestrians and public traffic occurs simultaneously in concentrated competition at plant approaches, a measurable traffic problem exists of concern to the community. The problem is serious in proportion to the degree of improper planning of in-plant traffic facilities and the lack of positive traffic controls in the immediate area surrounding the plant property. Overflow, unregulated plant employee parking along access highway; insufficient off-street loading space for buses, taxicabs, family cars and other pick-up vehicles forcing angle and double parking in traffic lanes; continuous left-turning of ve-

FIGURE 1. A Rural Plant Development Avoids City Traffic Congestion.

FIGURE 2. Haphazard Crossing and Turning Creates Dangerous Conflicts.

FIGURE 4. Promiscuous Parking on Roadway Margins Increases Congestion.

FIGURE 5. All-day Curb Parking by Employees Impedes Public Traffic.

hicles from parking fields across heavy traffic streams; haphazard crossings of mass employees on main access roads—these and other congestion evils result in delay, confusion, conflict, and accidents.

Fortunately, the duration of such peak movements is comparatively short; but, unfortunately, the streets and highways that must absorb these loads often lack sufficient capacity and adequate traffic controls to break down and disperse the load rapidly and safely. Almost too horrible to contemplate is the utter chaos created by a fire, explosion or other catastrophe occurring during an interval of shift-change when unregulated competition for roadway space is at peak intensity. Without some pre-arranged plan for emergency traffic control, traffic congestion can result in the blocking off of fire apparatus, rescue vehicles and other emergency services vitally needed to keep human and material losses at a minimum.

Industry's Responsibility to the Community

It is for reasons of economic and production advantage that manufacturers have developed plants outside the large cities. With these advantages goes the responsibility to prevent their operations from encroaching on the privileges and property of the public, which include free movement on streets and highways. The existence of any actual, or potential, traffic hazard to the public resulting from plant operation, warrants the immediate attention of plant management toward correction and elimination.

1. *Employee Parking:* Since the automobile is used primarily for transportation of plant employees, management must strive to provide sufficient off-street storage space for parking at the plant. The overall amount of land required for parking of various traffic units depends upon the number of vehicles to be accommodated and the type of parking planned.

A shift of workers arriving before shift-change to replace an equal or larger group that is leaving, imposes a load on the parking facilities about double that adequate for either shift. For a simple three-shift plant, the number of automobiles arriving for the next largest shift added to the number of automobiles needed for the main shift indicates the parking capacity required. The best estimate

of the actual number of cars to be accommodated is obtained through a questionnaire of employees of each shift. A quick rule of thumb measure would be one car for every three employees in each shift.

The minimum area required *per car* for "drive-in" parking at various angles is as follows:

Angle of Parking	*Area (Stall and ½ Aisle)*
90°	250 sq. ft.
60°	260 sq. ft.
45°	270 sq. ft.

Where practical and convenient a parking facility should be placed close to the plant building. Parking violations and property misuse by employees will be proportionate to the inconvenience caused them in going from the parking facility to the plant. A well-designed parking lot, incorporated as part of the plant premises, can add considerably to the functional efficiency and general appearance of the plant.

A parking facility should be located adjacent to one or more access streets of sufficient width to permit turns into and out of the lot without serious conflict with moving traffic. The ideal situation is a parking facility *between* two feeder roads, one road carrying vehicles to the lot and the other carrying vehicles away from the lot. In no case should the parking facility be placed so that the feeder connections with main approach arteries are restricted bottlenecks of insufficient width to receive and discharge vehicles using the parking facility.

Wherever control of flow within a parking field can be helped by portable signs or pavement markings, such installations are warranted. Directions and regulations should be explicit, brief, and plainly visible to drivers, with symbols used when feasible. A flow diagram of each parking lot should be posted on each bulletin board previous to opening of the lot and each employee-driver should be acquainted with all rules and regulations necessary to obtain the free flow desired.

2. *Accommodations for Transient Vehicles:* The number of transient vehicles that require parking accommodations at or near

plant grounds depends upon the nature of the business and manufacture conducted at each plant. These transient vehicles generally represent company executives, salesmen, servicing engineers, visitors, employees' families, buses and taxicabs.

Each transient traffic unit has a variable period of parking time need, yet all can be considered as *temporary*. To include these groups under the parking facilities designed for employee vehicles would be both incongruous and impractical. The very nature of this short-time parking demand necessitates providing "stand-by areas" that will permit the desired flexibility, and remove the transient vehicles from the roadways during critical mass movements.

Experience has proved that transient vehicles, unless properly regulated and accommodated, will contribute substantially to curb parking violations and other space abuses which in turn impede the free flow of vehicles moving en masse. The stand-by areas for transient vehicles can be distributed strategically at or near the plant premises in the form of separate parking rows of sufficient size to accommodate the transient unit assigned. Appropriate informational signs will serve to direct drivers of transient vehicles to their assigned stand-by area, thus eliminating confusion and misuse.

It is not always possible to segregate completely buses, passenger cars and pedestrians, but their coincidental use of the same road space or other area should be kept to an absolute minimum. Where substantial bus, taxi or transit service is required, provisions should be made for loading and unloading passengers at points separated from other traffic movements. Bus and transit stations in conjunction with loading platforms are a positive means of isolating these points of pedestrian concentration. They should be strategically located to one side of access roadways and as close as possible to the plant employee entrance(s), thus minimizing the opportunity for conflict with vehicles.

Bus loading points should be designed with broad aisles and stalls with raised platforms between the bus stalls to allow passengers ample protection while waiting to board, or when alighting. Parking stalls for buses should be at least fifteen feet wide and thirty feet long. Bus aisleways to the stalls should be a minimum of fifty feet in width.

Since loading platforms or waiting stations are often beyond the economic and cooperative means of those agencies concerned, bus loading at the curb is a most common means for accommodating employee passengers. This being the case, sufficient space must be *reserved* at the curb to permit buses and taxicabs to park parallel to the curb, free of moving traffic streams, and to allow employees to board or alight directly at the sidewalk. Complete prohibition of curb parking by other than the public carrier vehicles must therefore be enforced at these loading points.

3. *Pedestrian Facilities:* The handling of pedestrian movements is as important a problem outside of the plant building as it is within. Every care should be taken to reduce conflict between foot and wheel movements. When such conflicts *must* exist, the need for confining and regulating pedestrian movements is imperative.

All access roadways immediately adjacent to the plant and upon which groups of vehicles move in or out of the premises, should be provided with raised sidewalks to remove pedestrians from the traffic lanes. Cross-walks should be marked on the pavement at all intersections immediately adjacent to the plant where vehicle and pedestrian movements conflict. Marked cross-walks should also be provided at other appropriate points of substantial pedestrian movement—at long loading islands, or entrances to parking lots; where pedestrians are permitted to cross between intersections, or where pedestrians could not otherwise recognize the proper place to cross. Cross-walk lines should not be less than four inches nor more than twelve inches wide, and in no case be spaced less than six feet center to center.

Special pedestrian footbridges and tunnels may be warranted where pedestrians are required to cross main-line railroad tracks or high-speed highways in order to enter or leave the plant premises.

Routes to be followed by employees moving from the plant entrances to parking areas, loading zones and residential origins can be carefully planned and designated with the complete cooperation of the employees. Restricted turning movements, strategically located parking lot entrances and exits, and regulations for proper use of cross-walks and sidewalks are a few of the methods for encouraging safe and orderly routing of both pedestrian and vehicular traffic.

4. *Access Roadways:* Access roadways, referred to in this discussion, are intended to mean those roads, streets or highways adjacent to or abutting the plant premises, which together with intersections, side-streets, driveways, etc. compose the plant "approach." Access

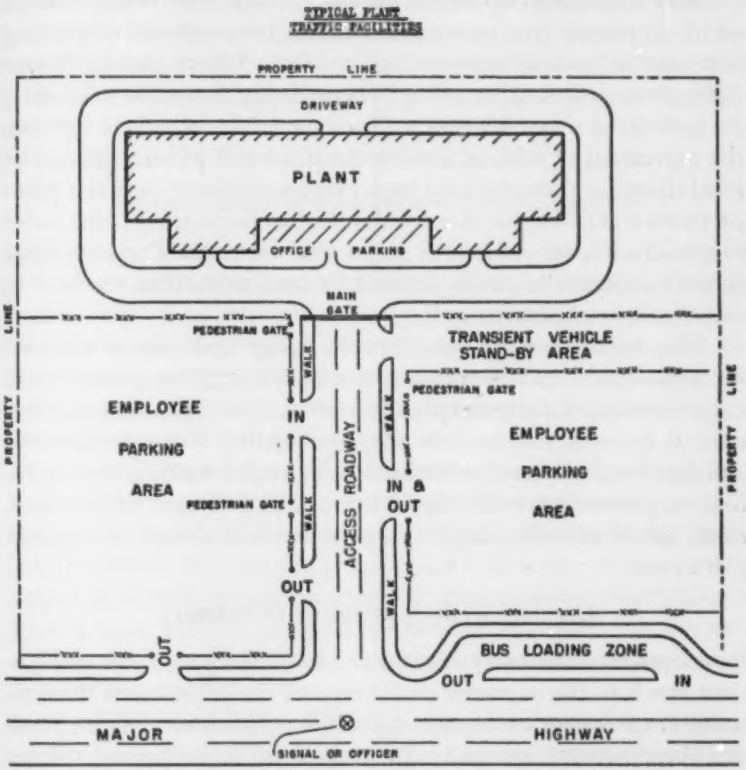


FIGURE 3. Long Access Roadway Reduces Conflict Between Plant and Highway Traffic.

roadways may be lightly-traveled rural feeder roads, heavily-traveled rural highways, or urban through-streets; they may serve the interests of the plant alone, or provide travelway for the plant, city, state and all abutting property. In any case, the importance to plant management of an access roadway lies in its fluidity and capacity to carry

large numbers of employee vehicles regularly to and from the plant with safety, order and rapidity. In addition access roadways may serve to carry large quantities of material which a plant receives or ships by highway.

Access roadways should in no case be less than twenty feet in width to permit free turning movement into and out of parking areas and to reduce intersectional conflicts. Where physically possible, plant premises, including parking areas, should be sufficiently set back from major highways to reduce critical conflicts between the movement of vehicles serving the plant and public traffic. The ideal situation provides long feeder access roadways between plant premises and principal thoroughfares, thus permitting plant traffic to spread out before it reaches major traffic streams. This advantage is more common to plants situated in rural areas than to those in dense industrial districts of large cities.

The requirement of special traffic design and control methods for access roadways will increase in proportion to the proximity of major thoroughfares to the plant premises. These special design and control features may include separate turning lanes, acceleration and deceleration lanes, cut-backs of curbs for bus loading, lane markings on pavements, traffic signal devices, SLOW and STOP signs, traffic officer controls, staggered hours for shift-change at adjacent plants, etc.

Community Responsibility to Industry

Development of industry in rural and small town areas has contributed much to the economic well-being of the inhabitants through stable employment under safe, agreeable working conditions. Modern plant construction, carefully landscaped, has enhanced the natural beauty and valuation of adjacent land. Residential subdivisions, originally developed on an unplanned, incomplete basis, have expanded into closely-knit, prosperous communities.

Insofar as a community has part in, or jurisdiction over, the maintenance and regulation of roadways adjacent to industrial plants, it is responsible for safe and expeditious movement of the road users. This responsibility is especially outstanding in cases where a community has procured industrial developments through

direct invitation, re-zoning or annexation. The latter method is most prevalent in the Southwest, and the former in the East.

In endeavoring to provide adequate terminal facilities and control of the approach and departure of employee vehicles, plant management must often look to public officials for advice and cooperation. This assistance is necessary in matters that overlap into the jurisdiction of a village, town, city or county and may include curb parking regulations, installation of traffic control devices, designation of one-way streets, deputization of guards, and emergency traffic control.

Mutual Efforts to Eliminate Traffic Congestion

With *congestion* defined as "an over-accumulation of anything by over-crowding" and in turn implying *conflict*, defined as "a struggle occasioned by incompatible desires," elimination of congestion means the return of order through reasonable, effective control. Such control can only be reasonable and effective when it is established by joint agreement and active cooperation of plant management and municipal administrators.

1. *Traffic Signal Control:* Usually the demand placed upon access roadways by employees, on foot and in vehicles, is extremely heavy for about a half-hour period. Within that half-hour shift-change period, as many as 48 percent of all traffic units must be passed in a peak ten-minute interval. From a plant discharging a total of 6,000 vehicles and 4,000 pedestrian employees, the demand during the ten-minute peak represents 2,880 vehicles and 1,920 pedestrians.

In addition to parking field exits, which of themselves represent a "T" intersection, access roadways may form a network which meets at one or more major intersections. Any heavy discharge of employee-vehicles and personnel into major traffic streams during period of shift-release, when combined with hazardous cross movements and marginal interferences, may well create a situation of sufficient seriousness to warrant special traffic signals.

The Manual on Uniform Traffic Control Devices[1] cites the fol-

[1] *Manual on Uniform Traffic Control Devices for Streets and Highways*, Public Roads Administration, Washington, D. C., August 1948.

lowing warrants for signal installation, applicable to industrial plants:

(a) FIXED-TIME SIGNALS (Sec. 209)

"In urban areas:

"1. Vehicular volume on the major thoroughfares past an establishment of the type mentioned above exceeds 800 cars per hour at the approximate time of major movement of traffic to and from the establishment, and traffic to or from the establishment roadway during the same period of time meets one of the following warrants:

a. A minimum of 300 cars per hour or
b. A minimum of 200 pedestrians crossing per hour, or
c. A minimum of 200 cars and 100 pedestrians crossing per hour.

"2. Left turns into or from the establishment roadway exceed 30 percent of the 800 cars per hour past the establishment.

"3. Four lanes of traffic moving past the establishment exceed an average speed of 40 miles per hour during major movement of traffic.

"4. A sharp vertical or horizontal curve or view-obstruction exists near the entrances or exits of the establishment, one or a combination of which creates a serious accident hazard.

"In rural areas:

"Warrants for establishments located in rural areas are 50 percent of the foregoing traffic volumes for major thoroughfare and establishment entrance or exit."

However these warrants are further qualified for periods of two or more consecutive hours when vehicular and pedestrian volumes fall below 50 percent of the minimum stated; then flashing operation of the signal is required.

(b) TRAFFIC-ACTUATED SIGNALS (Sec. 234)

"1. *Vehicular Volumes.* At intersections where the volume of vehicular traffic is not great enough to justify fixed-time signalization, traffic-actuated signals may be applied if other conditions are such as to indicate the need for Stop-and-Go signal control and if the cost of the installation can be justified by the conditions.

"3. *Peak-hour volumes.* When signal control is required at an intersection during only a small part of the day, such as during peak traffic hours, traffic-actuated signals may be installed if economically justified, since they will not unduly delay traffic at other times.

"4. *Pedestrians.* If the principal need for a traffic signal is to accommodate pedestrian traffic, traffic-actuated signals are usually desirable and may be economically justified. Most urban intersections with heavy pedestrian volumes also have heavy vehicular volumes and thereby warrant the use of fixed-time signals. However, signals may be warranted at special locations, such as in the vicinity of schools, when pedestrian crossings are the primary consideration. In these special cases, traffic–actuated signals will delay vehicular movements only when the streets are in use by pedestrians.

"5. *Accident Hazard.* When a study of intersection conditions indicates that signalized control would be an effective remedy for the accident hazard existing but the minimum warrants established for installation of fixed-time signals are not met, a traffic-actuated signal installation may be justified.

"10. *Speed Control.* If approached speed presents a particular hazard at intersections, in addition to normal intersection problems, full-actuated control employing speed control on the artery may be installed for best results."

The subject of traffic signal installation at industrial plants is, by its variable nature, a controversial one. Often the justification for traffic signal control depends on a combination of warrants quoted above. Other factors include the characteristics of the manufacturing process, the number of parking fields abutting on access roadways, the ratio of personnel to vehicles, the physical capacity of access roadways to disperse large traffic volumes in a relatively brief period, the duration of shift-release, and the proximity of other industrial plants discharging employees simultaneously.

Finally, the use of traffic signals, although a desirable solution, depends almost solely upon approval of the local, county or state traffic authority responsible. This authority must review the existing warrants for installation, and more often than not such requests are rejected. Another stumbling block is the lack of uniformity regarding traffic signal control application under local, county or state jurisdiction.

It is the opinion of nearly all state highway departments that the entrance to an industrial plant is a private roadway, and since all entrances to private property are in the same category, it is *not* the obligation or duty of the state to provide special or unusual facilities to any privately-owned industrial plant. However, this generally accepted policy by state and/or local authority does not preclude the

installation of protective devices, provided the controls meet with the approval of the traffic authorities. In the majority of cases in which permission is granted for traffic signals, it is usually stipulated that the industrial plant bear the expense of installation, and this item alone may prove prohibitive.

2. *Police Traffic Direction:* As an alternative to installing traffic signals at apparently hazardous locations, consideration should be given to effective control by a traffic officer stationed at the point of crossing or an intersection. Police officer control is the most flexible, commands the greatest respect and prevents a larger degree of violation than do other traffic control devices. Unfortunately few municipalities have sufficient police personnel to permit special assignment of an officer to an industrial crossing during hours of peak demand. If this is possible, there is little need for special sign or signal installation. The officer may coordinate his hand signals with those of any existing traffic signals in the immediate vicinity, thus permitting maximum efficiency of movement.

An alternative to direct police control is the assignment of a plant guard or other responsible employee, duly deputized, to direct traffic at the critical point of crossing. One objection to this is the fact that such deputized personnel are not sufficiently trained in traffic control and do not have authority to enforce against violations. Another determent to deputization in many cases is that plant guards, granted the privilege, may be subject to call at any time by municipal or county authorities to perform other police functions; the result is a disruption of assigned plant duties in matters of security and control.

3. *Curb Parking Regulations:* Where adequate provision is made for off-street storage of employee vehicles, the regulation of curb parking is not a problem. However, promiscuous parking along the margins of access roadways is quite common, even at plant locations with ample parking fields. The principal reason for this abuse is the desire of certain employees to get the jump on the outgoing shift. These particular characters, if forced to use company parking lots, invariably "hog" the stalls adjacent to the exits, or more commonly will park in parking lot aisles and on grass slopes. In any case, their poor parking practices serve only to reduce the

number of traffic lanes and increase the number of potential conflicts at shift-change time.

As with most traffic violations, it is the irresponsible few who must be culled out through selective enforcement. Treatment of curb parkers on access roadways requires a firm attitude by plant management and traffic authorities to carry out discipline and regulation, respectively. At some plants, physical limitations make curb parking a necessity, particularly for transient vehicles such as buses, taxis and family cars. The temporary space requirements of these vehicles can usually be handled satisfactorily through reasonable regulations, short of special privilege. Permissible standing during the period of shift-change, combined with careful control of space usage will eliminate much of the hazard and confusion often resulting from unregulated parking along access roadways.

Where curb parking extends to the all-day needs of plant employees, the situation usually proves serious, especially when there is any impediment to traffic flow on access roadways shared by public vehicles. In these extreme cases, cut-back and widening of roadway shoulders may be the only solution. Though it represents a granting of public property for private parking, such measures may be warranted to relieve traffic congestion and conflict, but then only as a temporary expedient. The only logical remedy is to provide parking space completely off-street on plant property, and insofar as abutters will not be unduly penalized, public officials should support plant management in their efforts to procure land for off-street parking of employee and other plant vehicles.

4. *Control of Approach and Departure:* When access roads to plant areas are major highways carrying through-traffic, directional signs and pavement lane markings may be required to permit employee vehicles to use entrances without interrupting traffic movement. Since the arrival of employee vehicles at a plant is spread out over a considerable period (usually three-quarters of an hour in advance of starting time) the turn-offs from the highway are fairly uniform and free of bunching. Usually, signal or officer control is not necessary for approach movements.

Because arrivals originate from all quadrants, both left-turning and right-turning movements occur from the major highways into

the plant area. It may prove necessary to provide a special left-turning lane to permit vehicles to await a gap in traffic without holding up through-vehicles passing to the right. If two or three gateways are used as entrances to parking areas along major access highways, proper lane markings will serve to direct decelerating vehicles into the right-hand lane as far back from each entrance as possible so that through-moving vehicles may continue in the adjacent left lane without being obstructed. The provision of right- or left-turning lanes will depend upon the width of the major highway, the time and volume distribution of employee vehicles, and the needs of through-traffic.

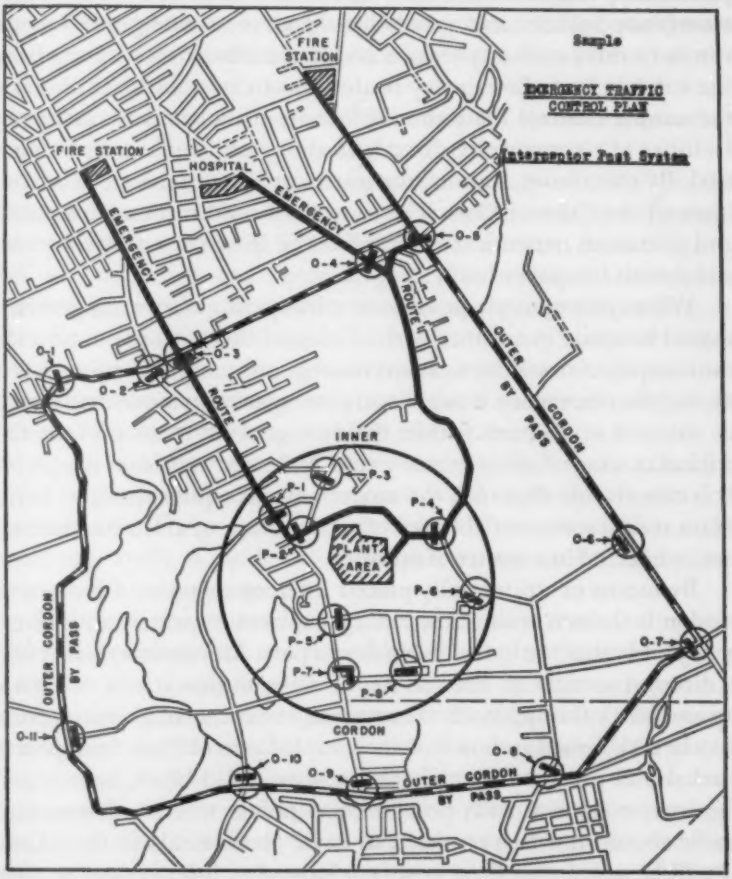
The maximum efforts of traffic control are required of course at the time of mass departure from the plant area. In addition to the possible need for signal or officer directional control discussed above, acceleration lanes may be helpful in permitting employee vehicles to merge quickly and safely with through-traffic streams, particularly where plant gateways abut major highways.

When access roadways are used primarily to serve plant vehicles, every attempt should be made to provide one-way flow of traffic between the plant premises and major highways. Strategic layout of parking lots will aid materially in providing one-way circulating movement. Unbalanced movements in or out on access roadways can be regulated also by assigning extra lanes to the heaviest direction of flow on arrival and reversing the procedure on departure.

One-way and reversible lane principles are excellent relief measures in communities where the heavy load of industrial plant traffic imposes congestion problems beyond the vicinity of the plant premises. The regular fluctuation in volume and direction of these mass movements permits flexibility and ease in establishing special traffic regulations during the relatively brief periods of flow. Retiming of signal cycles and special parking restrictions may provide additional means of accommodating predominant flow on the streets of a community, with adjustments dependent upon street capacity and the character and volume of traffic.

5. *Emergency Traffic Control:* At each industrial location, a plan should be developed to eliminate the possibility of serious traffic tie-ups of emergency vehicles in the event of fire, explosion or other

catastrophe. Fire apparatus, ambulances and other rescue vehicles must have free access to a stricken area if injuries and material damage are to be kept to a minimum. While plant officials usually have



Posts P1–8 within the "inner cordon" circle are manned by plant personnel to protect emergency routes in the immediate plant area.

Posts O1–11 are manned by city and county police and form the "outer cordon" to prevent vehicles from clogging the emergency routes leading to the plant. The "outer cordon" also serves as a by-pass route to shift traffic around and away from the emergency area.

established some form of disaster control, it seldom reaches beyond the limits of plant property.

Highway, fire and police officials can be of great assistance to plant safety engineers in planning which routes should be used by emergency vehicles and which should serve as emergency by-pass routes to carry curiosity seekers and non-essential traffic away from the stricken area. Emergency routes, shown in solid black lines on the sample Control Plan, should lead from the various emergency facilities of a community directly to the plant or plants to be serviced. By-pass routes, framing the outer cordon, are shown as broken lines on the Control Plan. These routes should form a continuous and circuitous network to drain off traffic from the emergency area and permit it to move freely.

Where emergency routes cross railways at grade, arrangements should be made in advance with officials of the railroads to provide the manpower necessary to keep crossings on emergency routes open during the emergency. Freight and passenger train movements must be stopped at all costs within the emergency area to prevent the critical cutting off of emergency vehicle flow to and from the plant. It is conceivable that with the modern signal equipment and minimum train crews available, an effective check of train movements can be effected in a matter of minutes.

By means of strategically placed interceptor posts, a protective cordon is thrown around the emergency area to permit only emergency and other authorized vehicles to pass. All non-essential traffic is directed to right or left and kept rolling so that it will not stack up and block the approach of emergency vehicles. Interceptor posts may be established as shown on the sample Control Plan. Each post is circled and given an identifying number. Solid black lines across the intersections at each post indicate points where non-essential traffic should not be permitted to enter access roads to the plant. It will be noted that these posts are located at intersections so that it is never necessary for directed vehicles to make a U-turn which would interfere with emergency vehicles and delay all approaching vehicles to the point where traffic would soon become blocked.

Interceptor posts, to form an inner cordon, are of primary importance and should be carefully selected. They should be manned

immediately to hold off and clear away from the plant area all public traffic that happens to be nearby when the catastrophe occurs. These posts should be covered by members of a Plant Emergency Organization because they are the only ones who will know soon enough and be near enough to reach the posts before public traffic has a chance to get inside the cordon and become a tangled mass around the emergency area. It will be noted that the numbers of these posts, shown on the Control Plan, have the prefix "P" indicating that they will be manned by plant police or deputized personnel.

Other interceptor posts (designated by the prefix "O" on the Control Plan) form an outer cordon designed to keep important access roads, particularly fire and ambulance routes, from clogging between the inner and outer cordons. These outposts should be manned by mobile state, county or municipal police (depending on jurisdiction) as soon as they can be notified through a prearranged communication plan. It has been found that after the first ten or fifteen minutes of directing traffic at the inner cordon, the difference in speed between vehicles rushing toward the plant and those of reluctant curiosity seekers diverted away from it, causes a backing up of traffic that will clog the approaches unless the load is taken off farther back. The outer cordon performs this service while at the same time traffic is guided along by-pass routes marked by broken lines on the control map.

If the emergency should occur while a shift is on the way to the plant, this shift should not be permitted to enter the stricken area until the emergency is over. It would only serve to congest and confuse fire fighting and rescue operations. Therefore, interceptor guards should treat employee-vehicles of an oncoming shift just as they would general public traffic and direct them off the main routes and away from the emergency area. It is well to have a prearranged assembly point outside of the emergency area where the oncoming shift can await developments and further instructions from the plant.

If an emergency should occur between shift-changes, there would be no immediate problem of controlling employee vehicles unless panicky employees attempted to leave the emergency area in their cars. This should be prevented by the plant guards at the parking

lot because a general exodus of hundreds of cars over the access roads in the opposite direction from that in which emergency vehicles are trying to travel to the plant might cause serious accidents and would most certainly delay the emergency vehicles. Employees should go by foot to a safe place and remain there until the Chief of Plant Protection approves their taking their parked cars out of the lots onto the highways.

A question may arise as to the use of plant employees for emergency purposes. The Texas City disaster of 1947 was an example of permanent emergency organization which was made completely inoperative by the very emergency for which the plant members were especially trained. However, the plant layout and nature of industrial processing at most plants permit the establishment of a plant emergency organization to control traffic. At plants where only one or two regular guards are used, the members of the plant emergency organization must be recruited, trained and deputized from various departments of the plant.

In cities where manufacturing is the main source of livelihood and wealth for the population every effort should be made to preserve the advantage of this economic security. A plant protective association should be established, composed of representatives from each plant, the police and fire departments and the railroads, to draw up a city-wide traffic interceptor control plan designed to meet emergencies occurring at any or all manufacturing plants.

6. *Staggered Hours:* A community-wide staggered hour program is a direct solution to traffic congestion in those areas where proximate industrial and commercial interests discharge large vehicle-volumes simultaneously or within a half-hour time differential. Without such a program, the best traffic control methods at a given industrial plant location can be thrown out of gear by the additional traffic volumes to be passed at critical intersections.

Complete cooperation is vital to the planning and execution of a staggered-hour plan, and requires the assistance of union officials, plant management, traffic authorities, transit officials, and other parties responsible for the concentration and movement of large groups. Mutual analysis and interpretation of production needs, travel habits, critical intersections, routing schedules, personnel-

vehicle ratios and other data will permit an equitable staggering over a sufficiently broad period to prevent traffic congestion.

In any evaluation of traffic operation, the basic criterion is the amount of space available to meet demands and provide proper usage. It follows, therefore, that the most logical solution to a traffic operational problem lies in establishing an equitable balance between demand and usage based on factual studies of space characteristics.

Fortunately, the nature of industrial development in outlying areas is such that a reasonable excess of land exists for expansion of traffic demand, both on and off the highways. Nevertheless, it is well to recognize that this margin of "space profit" is diminishing in direct proportion to the expansion of production facilities, essential manpower, and motor vehicle transportation at any given site.

Long range planning and mutual understanding between industrial and public administrators on matters relating to traffic control and regulation will assure safe and expeditious use of streets and highways, regardless of the extent of industrial development.

Another Underground Garage

VINING T. FISHER AND JOHN J. GOULD

Mr. Fisher became General Manager of the San Francisco Parking Authority on December 1, 1949. Former Manager of the Down Town Association of San Francisco, original sponsors of a Parking Authority, and Secretary to the Mayor's Citizens Committee on Off-Street Parking which made the official recommendation for such an agency, he was selected for the post because of his executive and administrative experience, and because of his familiarity with municipal problems. He is an alumnus of the University of California with a Bachelor's degree in Political Science.

Mr. Gould, a Consulting Engineer of San Francisco, has been identified with the engineering design of many large and industrial projects. He was in charge of the structural engineering design of all structures built by the 1939 Golden Gate International Exposition and the thirty-million-dollar Park Merced Housing Development. He prepared the structural design for the eight-and-a-half million dollar Telephone Exchange Building at Oakland. He designed a two million-dollar paint factory and a twelve-million dollar warehouse and wharf project for the United States Army.

SAN FRANCISCO in 1942 built the first underground garage in this country, the Union Square Garage. And in March 1954, when the new St. Mary's Square Garage opens for business, San Francisco will be the first city in the nation to have *two* underground garages.

The outstandingly successful example of San Francisco's Union Square Garage had great bearing on the decision to "do it again." When the San Francisco Parking Authority began to formulate its program for additional off-street parking in October, 1949, it benefitted from the Union Square Garage operation over its first seven years. The facility had far exceeded every estimate of revenues and of public service. Original forecasts on which the financing was based had estimated an annual gross operating revenue of $339,000. By 1950, the garage was grossing in excess of $1,000,000

a year. This gave ample evidence of public acceptance of underground parking.

Furthermore, the excellent restoration work of rebuilding the public park above the garage had convinced both the public and the Recreation and Park Commission that sub-surface areas of public parks and squares could be put to practical use without distorting their original purpose.

In addition, the Parking Authority fortunately inherited a vast amount of preliminary work on the idea of a second underground garage to be located beneath St. Mary's Park, accomplished before the Authority's inception.

As early as 1945, Carlton H. Wall, president of an important garage corporation, and others had advanced proposals for a garage at St. Mary's Square. Among others, Mr. Wall and his associates had devoted time and expense to preliminary exploration of the site and the preparation of preliminary garage plans. The principal civic organizations had approved and were advocating the idea. Moreover, private business firms had indicated a willingness to take part in financing the project, if approved. This was all of great practical value.

That was the background upon which the Parking Authority began work.

Problems

The Authority was first faced with determinations of site suitability with respect to size for desirable garage capacity; of desirable capacity for parking demand in the adjacent area, of accessibility, and of potential revenue for the cost.

The Authority could have proceeded with the St. Mary's Garage site or any other site in downtown San Francisco without fear of serious error, on inspection only, and without definitive analysis, as far as site selection alone is concerned, and for the following reason: The population and automobile registrations in San Francisco are so high in proportion to the city's land and street area that traffic and parking congestion is paramount throughout the downtown business section. Additional parking facilities are needed at almost any point.

For the period under discussion, San Francisco had a population density of 17,720 per square mile. Again reciting the figures in our calculations in 1950 as of July 1, 1949, (they have materially increased) San Francisco had a registration of 192,957 passenger automobiles, operating on 866 miles of city streets, within a land area of 44.6 square miles. That is an average of 4,386 automobiles per square mile and 217 automobiles per street mile. That is an average concentration per street mile substantially 10 percent greater than Los Angeles, the city that is said to "run on rubber." That is an average concentration in relation to area substantially 100 percent greater than the automobile concentration in Los Angeles, the city with an automobile for every family. That is probably the greatest automobile concentration of any major city of the nation. Little wonder that San Francisco has a traffic congestion problem!

San Francisco passenger automobile registrations had increased to 240,879 in 1952, and the total motor vehicle registration had reached 284,319. The Parking Authority, however, conducted a careful study of the St. Mary's site in particular, on the background of the great general demand for new off-street parking.

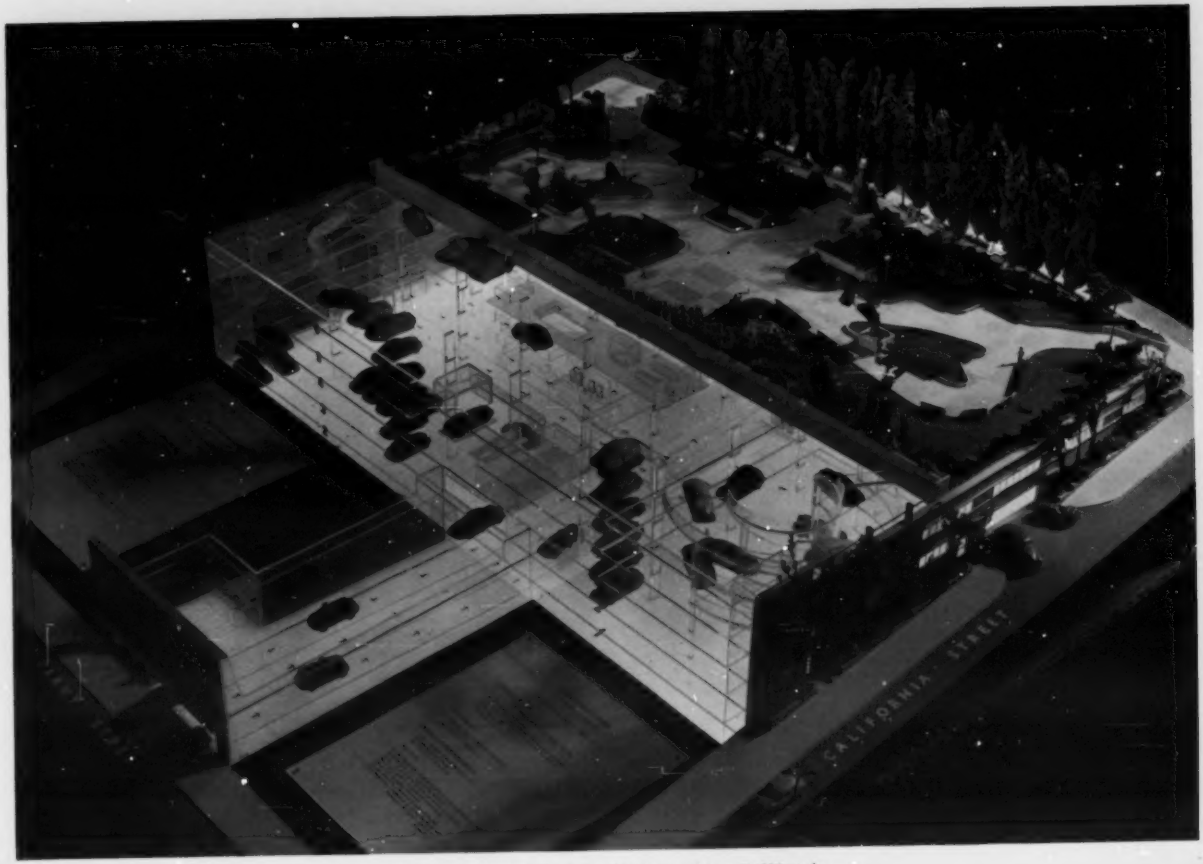
The first step was a study by the City Engineer of San Francisco of the area embracing four potential sites including St. Mary's Square. This study evaluated the unsatisfied parking demand for each site, construction cost estimates, and financial operating forecasts. A supplementary parking demand study for the St. Mary's Square site was prepared by the San Francisco City Planning Department.

The foregoing studies and their further analysis by the Authority developed two important facts regarding the proposed St. Mary's site and the unsatisfied parking demand in the area. These were that:

1. The demand was greater than previously anticipated and could not be satisfactorily served by a garage of the limited capacity that could be constructed beneath the Park alone.

2. The situation of the Park on a sidehill location with a 14 percent incline for pedestrian approach to the garage was felt would be a deterrent to prospective patronage of the facility.

Nevertheless, the location was considered right and the use of



St. Mary's Square Garage, San Francisco, California.

the sub-surface of the Park had the advantage of providing cost-free land without removing taxable property from the tax roll.

More Land Needed

After a careful evaluation of the problem, the Authority determined that it would be justified in acquiring additional land to accommodate a structure of sufficient capacity. It also concluded that a level accessway into the garage should be provided by the acquisition of land fronting on the adjacent main level street, Kearny Street, leading directly into the proposed lower garage level. These recommendations, unanimously approved, were adopted as the proper solution to the problems of capacity and access.

The net effect of the change was to add 27,039 square feet of land to the original park area of 34,375 square feet. That resulted in a site area of 61,414 square feet. This was accomplished by the closing of a small adjacent street, area 4,812 square feet, and the public purchase of 22,227 square feet at a cost of approximately $400,000. The funds for this purchase came from a $5,000,000 general obligation bond parking fund voted by the people in 1947.

With the definite determination of the site and land acquisition under way, the Authority next approached the problem of financing the construction of the garage. Three different methods were considered possible. These were by 1) revenue bonds, 2) general obligation bonds, or 3) private investment.

Because general obligation bond money with its lower interest rate was available, the Parking Authority did not give serious consideration to the question of revenue bond financing at the time. And although it was recognized that general obligation bond financing would produce the lowest net construction cost, the Authority preferred, and decided upon, private financing for the following reasons:

First, the Authority had announced in its first declaration of policy that it would seek the greatest possible participation of private business in the development of San Francisco's off-street parking program. Private financing, therefore, of the garage construction, if possible, was in keeping with its basic policy.

St. Mary's Square Garage, San Francisco, California.

Second, private business was able and willing to assume that responsibility subject to satisfactory inducements, such as a long-term operating lease.

Third, the use of private financing for construction, in this and future cases, would permit the ultimate development of many more parking garages if the $5,000,000 of public money available were devoted only to land acquisition for garage sites. Under this method, it was foreseen that some $12,000,000 of garage facilities might be accomplished from the $5,000,000 public parking bond fund.

The Authority therefore decided upon and recommended to the City, that the financing, construction and operation of the garage be undertaken by private business. The Authority began to solicit the interest of private business in such an undertaking in accordance with the following general plan.

1. The City and County of San Francisco would furnish the site on a lease basis for a maximum period of fifty years.

2. Consideration for the lease would be: a. Construction of a garage of certain minimum specifications at private expense and without cost to the city. b. A monthly rental to be paid the City during the period of the lease, such rental to be a percentage of gross operating revenues with a minimum guarantee, all to be determined on the basis of competitive bids.

3. Title to land and improvements to vest in the city and county from date of completion of construction subject only to the operating leasehold for the agreed period of the lease.

4. That the garage would be constructed in accordance with certain minimum requirements and specifications which would include the following: a. Restoration of the existing Park surface as approved by the Recreation and Park Commission of the City and County. b. Compliance with the building code and regulations of the City and County including earthquake proof design and construction. c. Of sufficient capacity to provide a minimum of 750 designed parking stalls. d. Aisle widths a minimum of twenty feet and parking stalls a minimum size of approximately eight feet by eighteen feet. e. Adequate reservoir space for the reception and delivery of automobiles. f. Public convenience facilities. g. Adequate space for sales and services, such as gasoline, oil and accessories.

Under the above plan, the lessee would not be required to pay taxes on the land and improvements but would be subject to a city and county tax on the value of the leasehold interest. The question of architectural design was to be a matter of individual determination by each bidder.

Procedure

The plan of procedure corresponded in most respects to that followed in the financing, construction and operation of Union Square Garage, with one important difference. That was the method of basing rental to the city on a percentage of the gross operating revenues rather than that of a predetermined flat rent. It was believed that the percentage lease would be fair to the lessee and at the same time secure a larger rent for the City in the event that the garage operating revenues should be greater than estimated as has been the case with Union Square Garage. In the case of the latter, the lessee pays only a flat annual rent of $5,000.

It was also believed that the source of funds for the private financing of the construction of St. Mary's Square Garage would be similar to that for Union Square Garage. Again, events justified this expectation. In the Union Square case, the first mortgage money was obtained from the Reconstruction Finance Corporation; the balance was subscribed by local business and property interests adjacent to the garage site and others. In the St. Mary's case, it was assumed, again correctly, that the first mortgage money would come from a life insurance company and that the balance would be provided by the lessee and associates. Also, that interim financing during construction would be furnished by the local banks.

The initial response to the proposed program for private participation was excellent. Some half dozen firms evidenced strong interest. The Authority proceeded accordingly to prepare the legal documents required for a call for bids on the above basis and subsequent events have justified that course of action.

Certain formidable obstacles were encountered at this stage and caused an extended delay in the publication of the call for bids in conformity with the above program. These were due to the unusual national situation existing at the time. Only a brief reference will

be made to these problems as the conditions from which they spring are now behind us and it may be hoped they will not soon recur. These obstacles were the extreme difficulty of securing critical building materials and credit restriction exemptions. In the final analysis, both the National Production Authority and the Federal Reserve Bank gave the clearances required for the prosecution of the project.

Four months before the call for bids, the Authority issued an analysis of its findings on the economic possibilities of the garage based on the economic studies and fiscal planning which had led up to its decision to proceed with the project. This was done to stimulate further private interest and to inform the public of the potentialities of the proposed method of private financing of the construction costs. As it developed, the Authority's estimates were exceeded by those of the individual firms which later submitted bids. It was intended to be the conservative estimate that it was, and it is set forth here as then presented:

"Question 1. Is there sufficient demand for the additional parking space to be provided to assure the economic soundness of the project?

Answer: It is expected that bidders will propose a garage of from 750 to 1,000 car parking capacity. The City Engineer's Report stated:

> "The analysis of parking demand in the vicinity demonstrates that between 700 and 1,500 additional parking spaces are needed and would be used in the vicinity if made available, and that the future trend will be upwards."

The City Planning Department made the following statement on parking demand in a letter to the National Production Authority dated April 19, 1951: "To meet 1948 demands in the vicinity of St. Mary's Square, an additional 1,245 public parking stalls were required. By 1970 it is estimated that 3,380 public parking stalls will be needed in the vicinity of St. Mary's Square. Automobile ownership and use at present is greater than estimated in 1948, so

that the demand for parking space in the area to be served by St. Mary's Square Garage is probably already well-advanced toward the 3,380 spaces ultimately required."

The facts disclosed above would seem to certify the economic soundness of St. Mary's Square Garage.

Question 2. Will the potential daytime and nighttime patronage assure operating income sufficient to amortize the investment and provide a reasonable profit?

Answer: A careful and conservative economic forecast of potential operating revenues and costs of a garage at St. Mary's Square location furnished the Authority by an experienced analyst estimates:

Net annual operating profit per parking stall—before rent, property taxes, income taxes and debt service charges at— $131.67

Assuming a garage of 1,000-stall capacity, and applying the above figure thereto, forecasts a net annual operating profit of— $131,670.00

Assuming a 1,000-stall garage and a construction cost of $2,000,000, additional annual costs may be estimated as follows:

Debt service charges, including interest and debt payments on $2,000,000 at 4% for 50 years—	$ 80,800.00 per year
Property and income taxes—	$ 20,000.00 per year
	$100,800.00 per year
Net annual profit after debt service charges and taxes, but before rent—	$ 30,870.00 per year

It is believed that the above net annual profit is sufficient to provide for a reasonable rental to the City and County and a reasonable profit on the bidders' investment, especially in view of the following:

1. The bidders' investment is expected to be but a small percentage of the $2,000,000 required to finance construction. Ac-

cording to the usual pattern of financing such projects, it may be assumed that:

a. $1,500,000 (or 75 percent) would be provided by a loan secured by the leasehold interest.
b. A certain amount of stock would be sold to a product distributor.
c. Additional stock might be sold to directly benefitting properties.

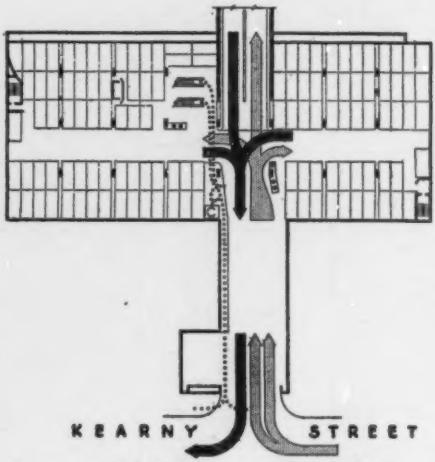
From the foregoing, it is evident that a comparatively small profit will show an excellent interest return on the bidders' investment in the project.

Furthermore: 2. There is a strong possibility that operating profits will be much greater than estimated above because: a. During the long period of the lease there will be an increasing demand for parking accommodations. Automobile registration and use are steadily increasing. Traffic movement will probably require prohibition of all parking on adjacent streets making the use of off-street facilities mandatory. New facilities induce greater use. *It should be noted that Union Square Garage operating revenues are three times greater than estimates predicted prior to construction.*

Question 3. What financial return and benefit can the City expect in return for the use of the garage site and its investment in the additional land?

Answer: 1. The City and County will have *immediate ownership* of the garage, and full control at the expiration of the lease period. Assuming the cost of construction at $2,000,000 and a 50-year lease, the City and County will receive the equivalent of $40,000 a year in the value of the improvement, which represents an interest yield of approximately 8 percent on its investment in the additional land. 2. Rent for use of the property. The amount cannot be determined until after receipt of competitive bids. 3. Increased taxes from improvement of adjacent properties.

Note: The Assessor has advised that assessed values of properties adjacent to Union Square have increased 47 percent since that garage opened in 1942."



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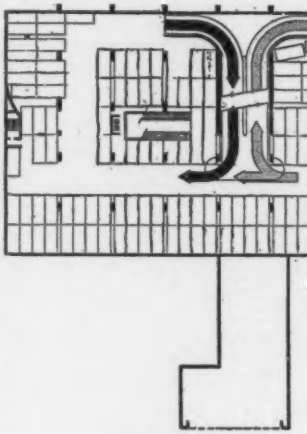

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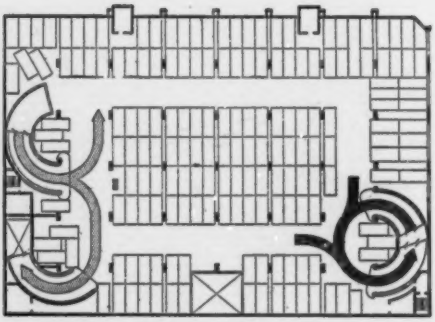

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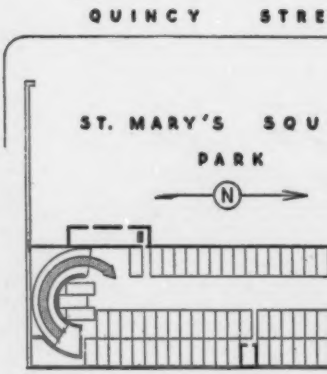

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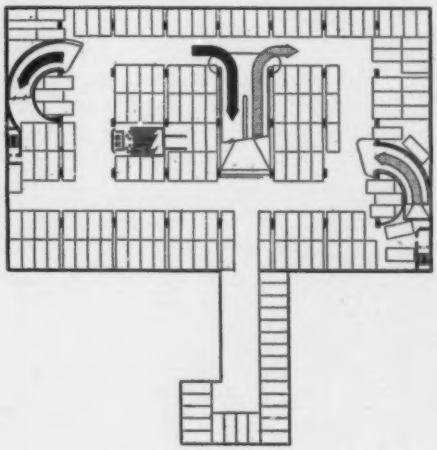

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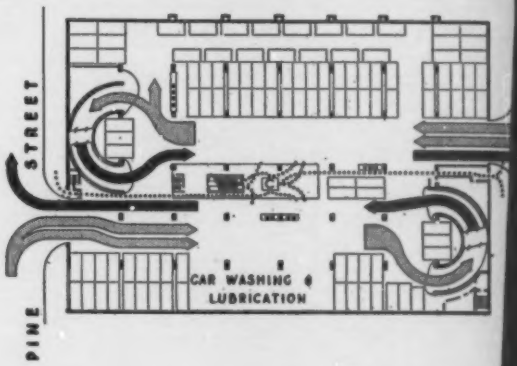

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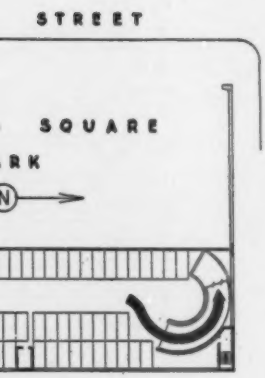

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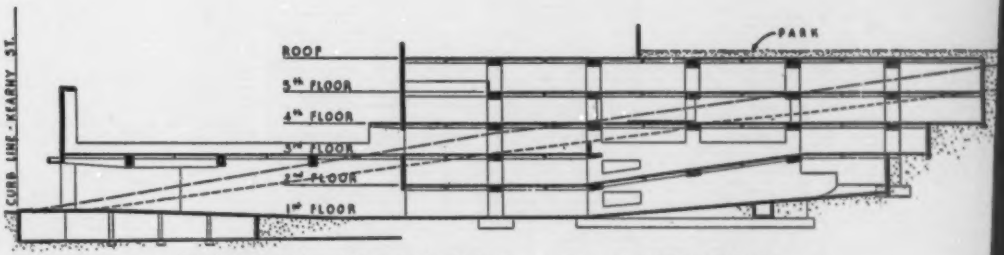
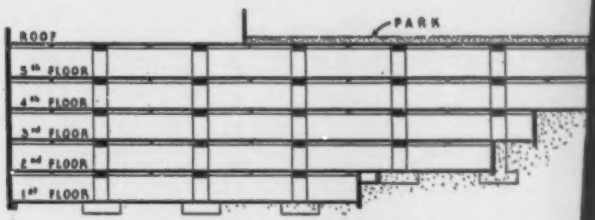


SECTION AT KEARNY ST. ENTRANCE

SCALE

LEGEND

- IN-COMING CARS
- OUT-GOING CARS
- MAN LIFTS
- CASHIERS BOOTH
- ESCALATOR
- PEDESTRIAN FLOW
- FUEL PUMP ISLAND



TYPICAL SECTION

St. Mary's Square Garage, San Francisco, California.

Bids for the private financing, construction, and operation of the garage were first published on September 26, 1951. Great uncertainty still prevailed at this time as to whether the National Voluntary Credit Restraint Committee would permit the life insurance company loan required in the financing of the project. As a result only one bid was received on the opening date of November 9, 1951. This bid was so qualified that it was necessary that it be rejected.

After the lifting of national credit controls on May 5, 1952, a second call for bids was published on June 21, 1952. Three bids were received on the opening date of August 4, 1952. The best bid was accepted and the lease contract signed on September 30, 1952. The pertinent features of bid and lease are given here: 1. Bidder and Lessee—S. E. Onorato, Incorporated and W. & B. Realty Co., Inc. 2. Period of Lease—thirty-three years. 3. Rent—4 percent of gross operating revenues, with a minimum guarantee of $1,225 a month.

The estimated construction cost was $2,100,000. Reference to the accompanying photographs of the garage model and plans will give a clear conception of its general design and projected finished appearance. Approximately one-half of the structure will be below ground and one-half above ground taking full advantage of its hillside location.

Other Considerations and Factors

In developing a design for St. Mary's Square Garage, one of the major considerations was to siphon traffic off adjoining streets at the fastest possible rate. This provision was especially important since California and Pine Streets are on a 15 percent grade. The garage has three entrances and exits—one on Kearny Street—one on California Street and one on Pine Street. The Kearny Street entrance leads directly into the first floor area, which is about three feet below the Kearny Street level. A three-lane magazine area approximately 160 feet long leads from Kearny Street into the garage. Entrances from California and Pine Streets lead onto the fourth floor, each entrance three lanes wide and a magazine space which is about 236 feet long. In this manner, about eighty cars can be accommodated in the magazine areas in addition to the regular stalls and aisles. The

maximum storage capacity for the entire garage is 1,025, of which there are 810 regular stalls.

Cashier and gasoline pump facilities have been provided at the first floor so that for all practical purposes the first and second floors can be operated as an independent unit from the rest of the garage if so desired. However, ramps are provided so as to inter-connect all six floor levels.

Two separate sets of escalators are provided extending from the first floor to the fourth floor level so that the public coming in from the downtown area over Kearny Street will have ready access to the entire garage without climbing any stairs or ramps.

On the fourth floor level are located a waiting room, cashier's booth and all facilities for washing, lubrication, greasing and the sale of gasoline. Also located on this floor are offices, public rest-rooms and employees' locker and lunchrooms.

Of the entire garage, 92 percent of all cars will normally have to travel only one floor up or down and only 8 percent will have to travel two floors to reach the sixth floor level which is located at the same elevation as the relocated St. Mary's Park.

To benefit the traffic pattern within the garage, it should be noted that the majority of traffic is expected to originate from a westerly direction through the California Street entrance in the morning. From the magazine area the cars will then be brought up a semi-circular ramp located near Pine Street to the fifth floor. Since these cars are in most cases expected to go west again in the evening, the cars will then be brought down on the ramp located near California Street and use an exit directly to Pine Street which is a one-way street going west.

For traffic coming from the east and coming up Pine Street in the morning, a reverse procedure is feasible since these cars will be brought down to the third floor. In the evening the cars will be brought up from the third floor and are then able to go east on California Street without crossing traffic.

Special consideration was given to various types of structural framing since the column spacing and location determine primarily the ease of traffic within the garage as well as the ease of locating aisle-ways and ramps. Generally speaking, columns were placed

thirty-three feet, six inches apart permitting four cars to be placed parallel with the long face of the columns. In the opposite direction, the columns were spaced thirty feet, eight inches.

Girders were made four feet wide and twenty-three inches deep and joist framing between them was built fifteen inches below the slab with a three-and-a-half-inch slab. The girders run in a north-south direction. By minimizing the number of columns as well as making them rectangular in shape, it was possible to then reduce the total area of the garage enabling us to build the bottom of the garage step-fashion thereby greatly reducing hazards incurred by deep excavation and assuring greater safety in the event of an earthquake. This was a major factor in bringing about desirable economies in this competitive venture with other proposals submitted to the City of San Francisco.

Construction began in March. It must be completed within twelve months under the contract. It is expected that a part of the garage will be sufficiently complete to permit some parking by December, 1953, and that St. Mary's Square Garage, San Francisco's second underground garage, will be finished and open for business in March of 1954.

The Relationship of Highway Design to Roadside Control

ALLAN LEE

Mr. Lee has been associated with the Maryland State Roads Commission for nearly a quarter of a century. For the last six years, he has headed the Division of Road Design. Previously he was a bridge design engineer. He served in a similar capacity with the Baltimore & Ohio Railroad for several years. Mr. Lee has been an Associate Member of the American Society of Civil Engineers since about 1940 and a member of the Design Committee of the American Association of State Highway Officials and Chairman of its Subcommittee Number 3, Cross Section Design. Between 1946 and 1948 he was an instructor in engineering mechanics on the faculty of McCoy College, of Johns Hopkins University.

WHAT do most of us understand by "roadside control," "controlled access," or similar terms? Is it a device intended to harass owners of commercial establishments along the highways? Is it a method of inconveniencing local traffic so that "foreign" or "out of state" traffic can zoom along certain routes and breeze through "our state" without stopping to buy a gallon of gas or even looking at the scenery? These views have often been expressed by local interests. If not these, then what is the real need and the real meaning of the term?

All of us have observed the highways built in our own particular states during the last fifteen years or so. Some of these have been two-lane highways, twenty-two or twenty-four feet wide, while others have been of divided-highway type, with traffic movements separated by an ample median. Practically all of them have been amply designed, with careful consideration given to structural make-up of the pavement, drainage, subgrade treatment, and geometrics. Many of us have observed, however, that some of these facilities are already obsolete, or in a state of fairly rapid obsolescence. Why has this occurred?

In most cases, analysis will no doubt show that the original right-of-way width was too narrow, and that commercial establishments were allowed to build up with little or no control until we have a condition approaching traffic strangulation caused by this fringe development. These statements of conditions provide ample meat for endless controversies as to the importance of any highway in opening up the territory and aiding the economy of the area through which it passes. However, with highway costs up to a million dollars a mile in some rural locations and many times that in congested urban areas, we must definitely think of preserving these highways for their prime function—moving traffic.

Some type of control of access to and from the highway must be exercised to preserve motorists' investment in the highway plant and not let it deteriorate to the intolerable conditions of parts of the Boston Post Road, and the Baltimore—Washington Boulevard—conditions which other writers on this subject have ably described. Will we have to exercise this control on every highway that we build in the future? Hardly, but each proposed new route must be closely studied for its potentialities of traffic and land use. The history of closely parallel existing routes in the vicinity will also help us to determine this necessity.

Highway Design Increasingly Important

It might be well to say a word here about the highway designer, if he is going to aid in designing highways so that early obsolescence will not occur. Not many years ago he produced plans that consisted of hardly more than a centerline and a profile grade line, with little imagination used or necessary in their development. Some members of the civil engineering fraternity regarded this type of work lightly, and avoided working in it themselves or recommending it to younger engineers as a challenging field of endeavor.

The field of highway design today, however, presents a wholly different picture. It is a field fraught with problems of structural, hydraulic, and geometric design, together with difficult interchange and intersection problems, as well as many others incident to controlled access, which we are talking about. Highway designing pre-

sents any young engineer today with an interesting field for using practically all the knowledge gathered during his college career.

Where and how does the highway designer fit into the solution of the access control problem? First, he must have the authority to exercise control, and this can usually come only through legislation. The legislative authority usually sets up some minimum capacity before control can be exercised. For instance, in Maryland the 1947 session of the legislature passed an act establishing highways of the "expressway," and "controlled access arterial highway" types which could be used on routes carrying 5,000 or more vehicles a day:

Expressway. The term "expressway" shall mean a major thoroughfare of two or more traffic lanes in each direction, designed to eliminate principal traffic hazards, and shall embrace all bridges, tunnels, overpasses, underpasses, interchanges, entrance plazas, approaches, and other structures, which the Commission may deem necessary to the operation of the expressway, together with all property, rights, easements, franchises and interests acquired by the Commission for the construction and operation thereof, and having the following characteristics:

(a) a median divider separating opposing traffic lanes to eliminate head-on-collisions and sideswiping;

(b) grade separating structures to eliminate the conflict of cross streams of traffic at all intersections;

(c) ingress and egress limited to predetermined locations;

(d) vertical curves of lengths sufficient to provide long sight distances; and

(e) shoulders of widths adequate to permit vehicles to stop or park off traffic lanes.

Controlled Access Arterial Highway. The term "controlled access arterial highway" shall mean a major thoroughfare of two or more traffic lanes in each direction having the same characteristics as an expressway, except that the conflict of cross streams of traffic need not be eliminated at every intersection by means of grade separation structures.

The actual denial of access to abutting properties, it may be noted, is not definitely set up in the legislation, but is left to the policy of the State Roads Commission.

It is interesting to note here that in at least twenty-six states some form of access control has been set up by means of legislative action. These states are: California, Colorado, Connecticut, Florida, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Virginia, Washington, and West Virginia.

In addition, Missouri exercises access control by means of constitutional provision, while a judicial decision provides for this type of highway in Minnesota.

It is difficult to set exact warrants leading to the establishment of control, but close studies of anticipated traffic and land use will enable the highway department's planning and design divisions to designate such routes. Certainly we do not want any more routes carrying fifteen to twenty thousand and more vehicles a day subjected to haphazard, on-and-off traffic from numerous commercial establishments built up to the edge of a narrow right-of-way, their lights and signs glaring into the eyes of all motorists using the route.

Overall control of access is usually described under two categories—one of complete and rigid control of all intersecting highways and properties; the other of a somewhat flexible nature allowing more leeway than the former. These types are variously described in different states, but as we have already noted, the first type is called an "expressway" in Maryland. All intersecting highways are separated, and complete denial of access of all kinds—vehicular, pedestrian and animal—is exercised over abutting property.

The other type, the "controlled access arterial highway," allows some highways to intersect at grade, depending on the traffic they carry, while the most important intersecting roads are separated. Also, a large property holding is allowed one point of access to the highway, if right-of-way costs would otherwise be prohibitive. Usually, however, direct access from abutting properties is denied.

Property Mosaic Affects Location

The design engineers may or may not be called into the picture regarding final stages of location as affected by the pattern of proper-

ties traversed. His participation will depend on the policies of the state with which he is associated. It is of prime importance that a complete property mosaic be assembled when the highway location is generally set as regards terrain, drainage, soil, and other ordinary consideration. Highways that deny access to abutting properties must naturally be closely studied as to how these properties are going to be crossed. If we can lay the line along boundary lines it is obvious that severance damage can be largely eliminated.

Also, we have the problem of providing access for the affected properties to the nearest existing public way by means of service roads. Sometimes, in the case of arterial highways, sizable savings can be realized by providing the properties with one access point. Close contact with the right-of-way engineer is of course essential here. We have found it desirable, where these service roads are necessary, to set up a separate right-of-way strip for them outside of the right-of-way line for the expressway, or arterial highway. Likewise, it is necessary and desirable to deny direct access for a fair distance back when intersections at grade are allowed, and of course for all ramp connections of interchanges when the grades of the two highways are separated.

Previously we mentioned the complete denial of access exercised in some states—that is, denial of access to vehicles, pedestrians, and animals. Denying vehicular and animal access obviously promotes highway safety and a free flow of traffic. Denial of pedestrian access seems just as important. We need not stretch our imagination very far to envisage some enterprising commercial establishments' enticing pedestrians over the right-of-way line, an action that would no doubt lead to eventual, serious retarding of traffic, and increased accident rate.

Although details of geometric design are hardly a part of this discussion, we would like to emphasize that attention should be paid to the design of both interchanges and intersections at grade, and particularly to the length of deceleration lanes from the expressway. On this type of highway some of the vehicles will probably be travelling at excessive speeds and they should be given every opportunity to decelerate before they reach the curves of the actual off-ramp. Where grade intersections are allowed, give them the closest study

so they will not become bottlenecks to impede traffic. Allow ample storage space for left-turning vehicles. We would favor islands and medians of contrasting color and nearly flush with the surrounding pavement.

Needless to say, wide rights-of-way are a must to insure long life and continued safe use of any new highways being planned. If economically possible to acquire, a minimum right-of-way width of 200 feet is highly recommended.

Benefits vs. Costs of Controlled Access

Highways discussed here are not cheap. Including rights-of-way they will cost from half a million dollars a mile upwards. They are not popular with the owners whose farms or other holdings are crossed. Rights-of-ways are more difficult to acquire and cost more than for ordinary highways, averaging perhaps 175 percent for the expressway and 125 per cent for the controlled access arterial highway, as compared to conventional highway.

Eventually most persons will realize the necessity for these highways as a safe and desirable segment of the highway system. Access control will generally preserve any desirable aspects of the land adjacent to the highway on which it is used. Certainly, for residential use, it will encourage the establishment of carefully planned developments not too far from access points, rather than a mere fringe of unplanned buildings so often seen. Also, land adjacent to access points becomes highly desirable areas for restaurant, motel, and shopping facilities. Such development is already an actual fact, and on a rather large scale in some areas.

In the overall picture, these controlled-access facilities will be much more beneficial to the economy of the adjacent areas than the older uncontrolled highway ever was. They will encourage development "in depth"—insofar as residential use is concerned—rather than of the fringe type. Large developers can readily be attracted to an area if they are assured of ready and rapid access for their purchases to urban centers, or to industrial centers.

Likewise large business will be attracted to areas in the general vicinity of interchanges or other points of access. Here again they

will be of the well planned type rather than strung out along the highways as formerly. These highways will tend to zone themselves in this manner, by attracting commercial interests to the vicinities of the interchanges, while residential, farm, estate, and recreational use will naturally gravitate to those areas between access points. Finally, no matter how much development occurs, these highways will never be strangled into a wasted investment by excessive fringe development.

We may say a final word in connection with safety on these controlled access highways. They should develop into the safest type of highway yet built. Some of the toll roads, unfortunately, have not so far borne out this prediction. Much is up to the motorists themselves. To the writer what all of us need develop is (1) patience in our driving, (2) a real sense of consideration for other motorists on the highway, and (3) observance of motor vehicle laws. This borders on the ideal and may never be wholly realized. Strict speed law enforcement will therefore be necessary on these highways, because this will, no doubt, be the chief cause of accidents. If the motorists know they are being subjected to a radar type of speed checking and enforcement, they will probably stay within prescribed limits. If trucks are allowed on these highways, strict speed law enforcement against them as well as against passenger cars will prevent their becoming major causes of accidents.

As desirable, and as helpful as access denial is, and is going to be, on many of our new highways, we know that this control cannot be universally applied. Probably a few areas will not, for a long time, come around to the viewpoint that the control is necessary, and their legislatures will reflect this attitude and fail to provide them with the necessary enabling laws. Then again, some rural highways, although important, will not build up to a traffic density where control can be justified. Finally, we have with us our vast existing highway system, most of it built in an entirely different transportation era from that of today, with a considerable portion of it being subjected to the fringe strangulation mentioned several times before.

Let us first take a brief look at our existing highways and consider for a moment whether there is anything we can do to help the situation. Most trouble on these highways comes from the intense, uncon-

Maryland Route 2, looking north to the Glen Burnie Intersection. This is a highway without access control and the portion shown shows a sad condition of unchannelized commercial establishments.

Maryland Route 2, looking north from Mountain Road, Maryland No. 177. Same highway and a filling station whose entrances have been channelized although the highway itself is of uncontrolled access type.

Intersection of U.S. 301 and Maryland 5. This is a "before" picture and shows the hazardous conditions existing. Especially on weekends, this was always congested.

The same point as described above with the new construction well along. The restaurant and filling station will be removed. The southbound lane of U.S. 301 now crosses Maryland 5 on structure shown and converges south of the intersection.

trolled, commercial development along them. Our own Baltimore-Washington Boulevard is an outstanding example of a facility where side friction has developed to an almost intolerable degree. As an approach to a remedy of this problem, Maryland's State Roads Commission had introduced a bill before the 1951 legislature which passed and became a part of the Acts of the General Assembly of Maryland, 1951 session. It reads as follows:

"21A—In order to promote and further highway safety, the State Roads Commission is hereby authorized to limit the widths of points of existing ingress and egress and determine the locations of same that any commercial or industrial property owner or user may use into any existing state highway or section of state highway that carries an average traffic volume of more than 2,000 vehicles a day, such traffic volume to have been determined over a period of one year by procedures heretofore used by the State Roads Commission to establish densities of traffic. The commission, if determined expedient for traffic safety, may so limit such width and location by any method it deems desirable, provided, however, that nothing herein contained shall be construed to give the Commission the authority to deny any abutting property owner all access along any state highway except along freeways as defined in Section 150 of article 89B of the Annotated Code of Maryland (1947 Supplement)."

We cannot emphasize too strongly that this law applies to all state highways carrying 2,000 or more vehicles a day, and similar legislation is recommended to all states that hope to improve the congested fringe conditions along many of their highways. In the application of this law the public authority must obviously proceed with tact, and with a desire to continue its good public relations. Commercial establishments have already installed channelization as a result of this legislation, and as owners of these establishments become convinced that benefits will accrue to them as well as to the motorists—their source of revenue—we believe that more of them will be glad to co-operate in this form of rehabilitation of their highways. The highway design engineer is definitely an important factor in this phase of work, since he will help to plan efficient, smoothly blending types of commercial channelizations for these many locations.

Where Access Control Is Lacking

We are finally concerned with new highways where access control will not be exercised, due either to lack of necessary legislation, or to insufficiently anticipated traffic volumes. The highway design engineer must be especially alert in these instances to use every design factor that will lessen side friction or any other type of traffic congestion. First, he should do everything possible to see that a wide right-of-way is used. For a 24 feet-plus pavement (two lane undivided type) a right-of-way width on the order of 75 feet or 100 feet is recommended. If it is necessary to build a divided highway without access control then it is recommended that no right-of-way width less than 200 feet be considered.

For both divided and undivided uncontrolled highways, we must carefully consider all commercial establishments along them. If legislation exists which empowers the highway department to designate points of ingress and egress, then the highway designer should participate in the solution of all of these problems, and solve them so that on and off movements will easily blend with the main traffic movements on the highway. If such legislation is not available, then it is recommended that standard entrance designs be prepared. Such well planned entrances are really as much of an advantage to the property as to the highway, and probably the Rights-of-Way Department agents would have no trouble in "selling" them to the commercial developers.

Intersections must also be carefully considered. Where two important highways have their intersection at grade it may be well to install carefully planned channelizations. Here again it is hard to prescribe any hard and fast warrants for their use, and we have found none which are universally accepted. Contrasting colored islands and medians, raised but slightly above the surrounding pavement, are particularly effective. Storage space for left-turning vehicles is absolutely necessary to prevent the main through-flow of traffic from being retarded. We feel therefore that in the case of these highways which must be built without control, if we use a wide right-of-way, and pay close attention to the channelization of commercial enterprises and intersections, we will be in a better position than

when we built these roads on a moderate or narrow width of right-of-way.

Highway design engineers of the present era are actively engaged, by their work, in the betterment of traffic flows along both our new highways and those rehabilitated from plans prepared under their direction. As in all other organizations, co-operation of various departments builds a good team, and co-operative study between design, rights-of-way, traffic, construction, and maintenance will lead us to the best solutions of our many varied problems.

The Integration of Expressways With Other Urban Elements

HARRY W. LOCHNER

Mr. Lochner is senior partner of a Chicago firm of consulting engineers. He was employed by the Cook County (Illinois) Highway Department at Chicago from 1927 to 1944. During that period, he served as Construction Engineer, County Highway Traffic Engineer, and Assistant Chief Engineer. He had direct responsibility for and the supervision of all phases of traffic engineering, highway and bridge planning, and design. Through his firm, he has served as a traffic and highway consultant to the State Highway Departments of Arkansas, Louisiana, Georgia, Tennessee, Kentucky, Illinois and Connecticut, as well as numerous municipalities. His work has involved various types of traffic surveys, analyses of traffic statistics and facts, planning highway improvements, including roads, bridges, viaducts, grade separations.

THE primary aim in the location of expressways is the accommodation of major traffic movements. Beginning at the edge of the city, connections are made to one or more of the principal highways, ordinarily to the one carrying the heaviest traffic load in the metropolitan area. To warrant the heavy investment required of expressway development, the location should pass through or in close proximity to the residences of a large number of the city's population.

In most cities in the 100,000 to 400,000 population range, the distribution of population is unsymmetrical, with concentrations along some axis much greater than in other directions. Along these lines the greatest gain can be achieved by the construction of major carriers.

In all cities the greatest area of traffic destination is the central business district and its surrounding wholesale facilities and rail terminals, and it is natural for the expressway to be located to give service to the heavy movements to the central zone. Examination of the origins and destinations of traffic at the approaches to the central area usually shows that, while the movement to that area is pre-

dominant, the numbers of motorists destined to points beyond it are also of major proportions.

Thus the expressway is located at the edges of the business district so that through-movements will be served as well as terminating movements. A peripheral location is also the best solution because of right-of-way values and because some space is required to avoid the dumping of expressway-leaving movements into the busier downtown streets.

After leaving the central area the expressway usually moves outward along another heavily populated axis and makes connection to some important external highway at the edge of the urban community. These then, are the basic criteria for expressway location—connection to major highways at the edges of the city, passage through the city along or near the axis of principal development, and location past, but not through, the central business district.

In most cities one or more alignments can be laid down which will meet these criteria. The selection process then is concentrated on the economic and service factors present or inherent in the alternative locations. It is at this stage that the integration of the expressway with the several elements of the urban community can lead to decisions as to the best alignment and configuration.

Expressways Can Re-Vitalize Civic Developments

One of the primary considerations is the blending of the expressway with civic centers. Almost every large city has plans for civic building development, elements of which exist, with the completion of the balance pending financial or other developments. Frequently the plans for such centers were laid down prior to the evolvement of the expressway as a means of solving the traffic problem, and it is possible to blend the expressway with the civic elements in such manner that the expressway alignment is made less costly, and the civic center receives the fresh stimulus necessary for continuation or completion.

Little Rock, Arkansas, presents an example of the integration of expressways and civic centers with advantages to each. The worst traffic snarls in the entire community occur in the business district at

the approaches of the two bridges leading across the Arkansas River. Investigation showed that the two structures proper offered sufficient capacity for many years to come, and that the trouble lay in the introduction into the busy downtown streets of all traffic crossing the bridges, even though 69 percent of it had destinations beyond that area.

It was decided to build an expressway to intercept the through traffic before its entry into the downtown area, and to carry it around the business district on this high calibre facility. The river front area, through which this traffic interceptor would run, had long been considered as a possibility for civic improvement, since on abutting property were located the Pulaski County Courthouse, the city hall, the municipal auditorium and the cherished war memorial Building. When based on aesthetic considerations alone, the cost of developing the river front area had always appeared disproportionate to the benefits to be achieved. With the consideration of the river front as a location for the interceptor expressway, there occurred the possibility of a combination plan that would include the necessary trafficway as well as an improved, useful and handsome water front.

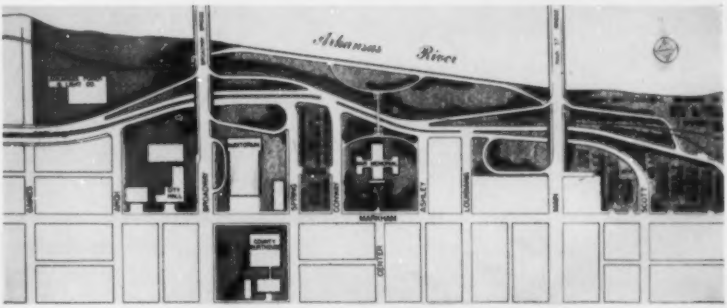
Features of the plan include ramp configurations permitting complete flexibility as to bridge route selection, a grade separated pedestrian connection between the war memorial and a scenic river front promenade, and the development of several landscaped parking areas which will serve the needs of business district patrons as well as visitors of the civic group.

Citizens of Little Rock passed a one-million-dollar bond issue to construct the project, as conceived by this firm in 1948, and this amount has been matched by the federal government. The state has budgeted $400,000 for the construction, and the expressway should be a reality by the end of 1953.

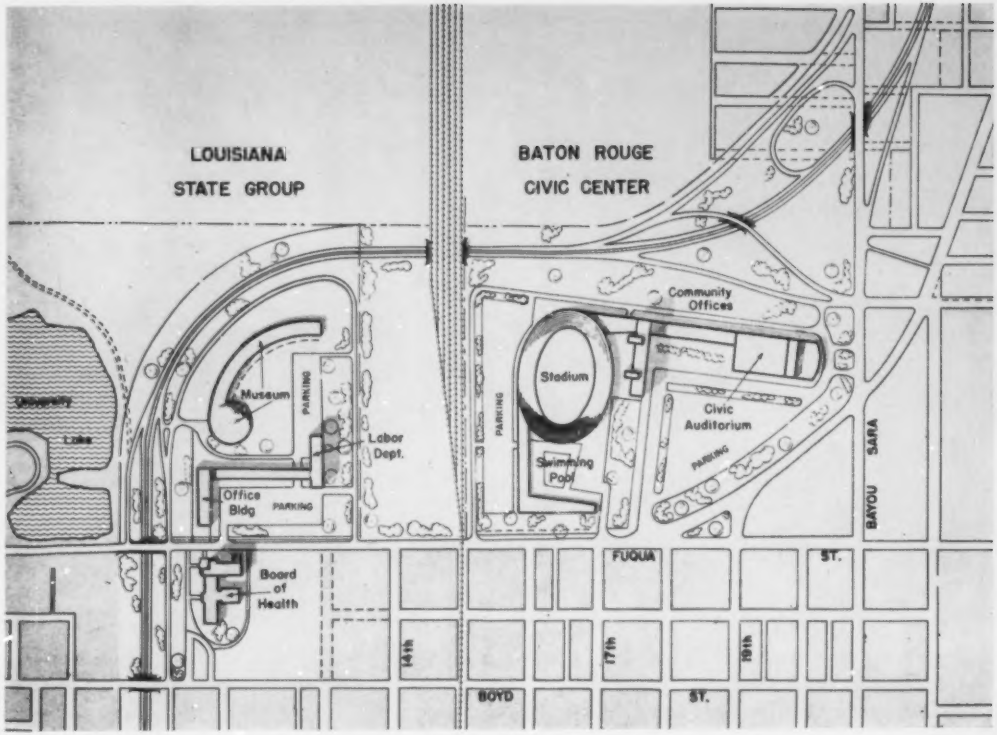
Baton Rouge, Louisiana, also presents an example of the integration of expressways with civic developments. A large parcel of property adjacent to the capitol had been acquired by the state legislature to prevent its commercialization and to permit its development as a community asset. The property lay on the logical alignment of an expressway connecting the Baton Rouge central zone with an extensive industrial and residential area as well as the

Julian Michele

Delineation of the Capitol Hill Project in Nashville, Tennessee.



River Front Expressway for Little Rock, Arkansas.



Baton Rouge Expressway and Civic Groups.

airline highway. This condition made it essential to study the future development of the property and to plan its use in such a manner that there would be a mutual enhancement of the values of the expressway and civic area.

The state-owned properties were divided into two parts by the presence of a railroad switch yard, hence it was quite logical to plan the part nearest the capitol for state use, and the other parcel for the community project. The state group would contain a central state administrative building, a laboratory for the state board of health, a building for the department of labor and a museum for the exhibition of the industrial and commercial activities of the state. The civic group would include an office building to house the activities of the city and parish agencies, a community auditorium with facilities for the civic theater, a large municipal swimming pool and a stadium for outdoor athletic contests. Adequate parking facilities are planned to serve the several elements of each group.

The expressway was located around the northern and western sides of the two areas and grade-separated from the dividing railroad trackage. In this fashion, isolation of the civic area from the balance of the community by an intervening expressway alignment was prevented. Ramps were provided to exchange the heavy movements between the through-lanes of the expressway and the traffic terminal facilities of the areas. Care was taken to provide adequate deceleration and sorting distance between the ramps and the parking areas. By means of grade separations the proposed State building area is directly connected to the existing State Capitol grounds. Development of this coordinated plan will result in benefits to expressway users as well as the community as a whole.

The stadium has been built on the selected site and acquisition of right-of-way for the expressway is now under way. Early construction of this vital trafficway is anticipated.

Nashville, Tennessee, presents an example of planning expressways in coordination with other elements of the urban community. Like most large cities in which the business center lies on the banks of a river, Nashville had the problem of the through-traffic using its principal bridge being forced through the congested downtown streets. An additional bridge is required with a by-pass expressway

to carry through-traffic around the central area. The district through which the by-pass facility would run is occupied by the State Capitol building adjoined by inadequate state office building facilities and the entire group adjoined by one of the city's worst slum areas.

The new bridge, and the older one a block away, would be operated as one-way crossings and would be grade-separated at their approaches from a major carrier to be located along the river front. One block from the approaches in the vicinity of the existing public square, the new route would swing to the west, circle the capitol and the business district and make connection to several elements of the state highway system.

All major streets entering the business district normal to the path of the expressway would be grade-separated from it. Immediately abutting the new route in the vicinity of the bridge approaches would be developed a new farmers' market which would have access to the new route as well as grade-separated connections to the river front distributor. Proceeding past the public square, the route would swing away from the business district and follow the natural grade of the terrain. Abutting the route and connected to it by means of service drives would be a series of large store and office buildings to be developed by private enterprise.

Behind these buildings large parking areas would be developed to serve patrons of the business group. Across the expressway would be three new state office buiildings which, like the business group, would be served by large parking areas. At the foot of the hill on which is located the impressive Capitol would be a large municipal auditorium. Because of the steep slope, vehicular storage facilities for this element would be located beneath it on five levels, with each level independently connected by means of ramps to the expressway service drives. Across the expressway from the auditorium is proposed a large park which will contain a swimming pool and other sizeable recreational facilities.

Again extensive parking areas are planned with care taken to avoid disruption of through-travel at peak hours by means of adequate service and sorting connections. Continuing, the route would serve another new business area and a large apartment district to be privately developed.

Expressways as Aids to Mass Transportation

In addition to lending new impetus to civic developments, expressways can render vital service to larger cities in the expansion of mass transportation facilities. Our largest cities usually present a variety of mass transit types. The central area of Chicago, for example, is served by five major suburban rail lines, four elevated transit routes and, of course, a network of surface buses and streetcars.

Trains and elevated lines serve relatively small areas adjacent to them, and the bulk of the mass transit patrons employ the surface carriers. With the large growth in automobile traffic volumes, the surface carrier system operates less and less efficiently and a circle has been created in which there are continuously more automobiles and less transit service.

With the development of the expressway, it is possible to acquire additional right-of-way for the development of mass carriers which operate along the unused median strip. In this manner new transit lines are created at minimum cost and between areas requiring additional service since, as was pointed out previously, expressways are usually developed along lines of intense concentration of population. Thus in the planning of expressways it is possible to incorporate mass transit lines which could otherwise not be afforded, and to present these new lines with rights-of-way entirely unhampered by street traffic and other inhibiting elements.

Expressways Can Help Check Blight

In almost all of our cities, and certainly in the larger ones, there is the threat of blight to stable residential areas because of the nearby presence of industrial or rail terminal facilities. The expressway can often be located in such a manner as to provide a buffer between these conflicting urban elements and, while serving both, can protect the residential neighborhood from the ill effects of industrial encroachment.

Potentialities of correlated benefits of expressway development are almost unlimited. They increase with the size of the city. They require a meeting of the minds and the coordination of thinking of

all types of planning and planners. This does not mean that the expressway location should be warped around to serve all purposes, but in meeting its primary objective—traffic service—it can also serve many other useful purposes.

These Traffic Factors Are Involved In Intersection Design

FRED W. HURD

Mr. Hurd is an Associate in Research with the rank of Associate Professor at the Yale Bureau of Highway Traffic. Previously he had been a highway designer and project engineer for the Missouri State Highway Department for ten years, a traffic engineer for the Missouri State Highway Department for two years, a traffic engineer for the Michigan State Safety Commission for one year and a traffic engineer for the Michigan State Highway Department in the Planning and Traffic division for three years.

INTERSECTIONS are frequently the worst "bottlenecks" of a road system. All traffic flowing on intersecting streets and highways must converge so vehicle paths may cross, join or divide as individual motorists follow their route of travel.

Sharing a common area by intersecting flows produces vehicle conflicts in time and space that determine the intersection's safety of operations and its capacity. Design establishes the geometry of intersecting maneuvers. Traffic regulations and control modify the time of maneuver.

Drivers measure the quality of an intersection's performance in terms of the delays they experience. At some intersections vehicles must stop; others are designed and operated to avoid such delays. Many types of intersection design with combinations of design and regulatory controls produce various degrees of operational efficiency. There is no simple formula.

Maneuver Areas

Vehicle paths may cross, merge or diverge at intersections. These maneuvers are performed in crossing, merging or diverging maneuver areas. Intersections consist of groups of these areas. Operating characteristics of individual maneuver areas and their operational

inter-relationships determine the efficiency of intersection performance.

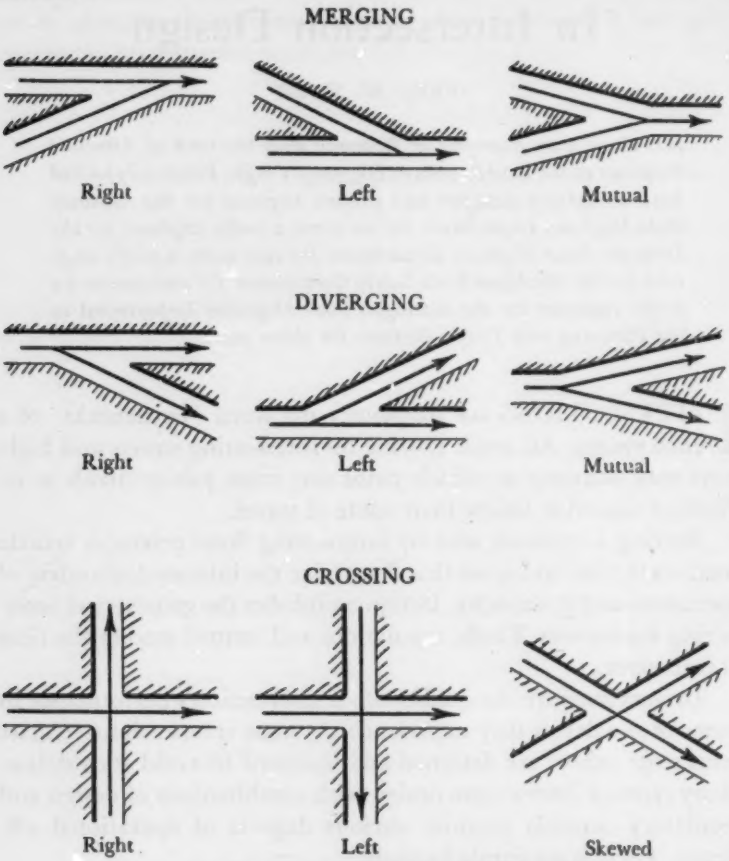


FIGURE 1. The Three Elemental Maneuver Area Types.

Maneuver areas may be elemental or compounded. Elemental maneuver areas accommodate the crossing, merging and diverging of two one-lane one-way traffic flows. The three *elemental* maneuver area types are illustrated by Figure 1. The operation and design of elemental maneuver areas, compound maneuver areas and the interrelationships of maneuver areas will be discussed in the order listed.

Relative Speed

Relative speed is an important product of maneuver area design and regulation. Relative speed is the rate of convergence of two vehicles as they approach a point of potential collision. Elemental maneuver areas designed and operated for low relative speed are inherently safe, cause the least delay and operate at higher capacities. The efficiency of the performance of elemental maneuver areas *decreases* with *increased* relative speed.

RELATIVE SPEED AS PERCENT OF LOWER SPEED

Inters. Angle	Ratio of Higher Speed to Lower Speed 1 : 1	2 : 1	3 : 1	4 : 1
0°	0	100	200	300
30°	52	124	219	316
60°	100	173	265	361
90°	141	224	316	412
120°	173	265	361	458
150°	193	291	388	489
180°	200	300	400	500

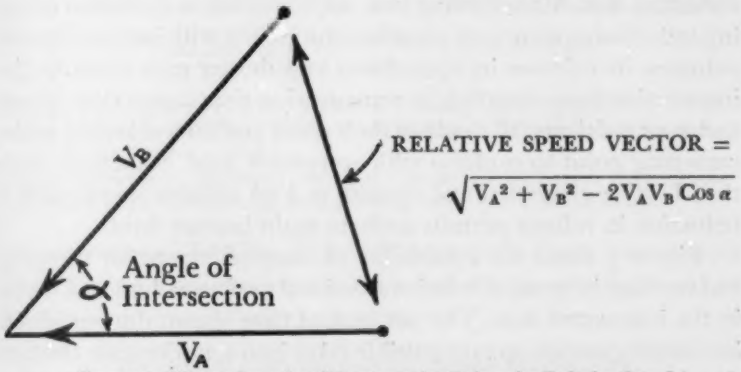


Figure 2. Illustration of and Comparative Values for Relative Speed.

Figure 2 illustrates relative speed and shows the comparative values of relative speed for various angles of intersection and dif-

ferences in the speeds of intersecting vehicles. The figure shows that relative speed increases with increased difference in speed and with increased angle of intersection. It is important to note particularly that intersecting maneuvers at low relative speed are possible only when *both* the angle of intersection and difference in speed are small.

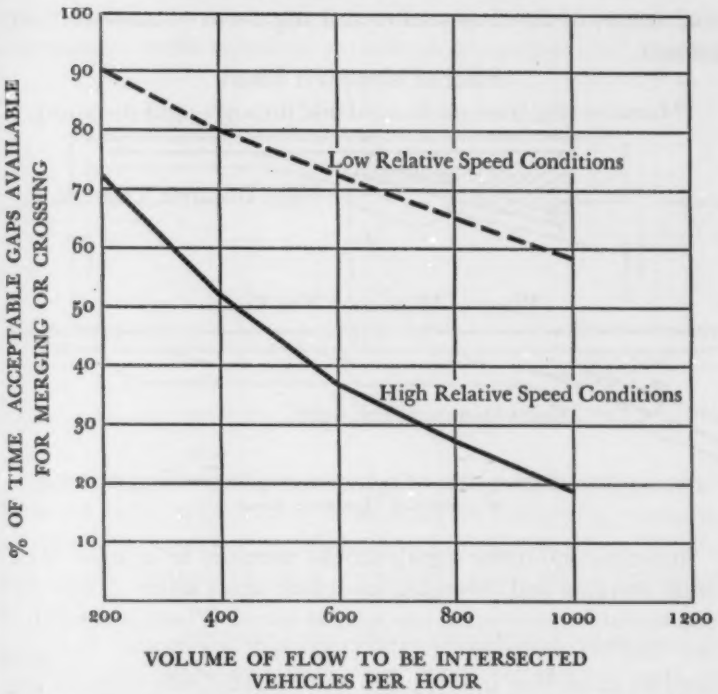
Maneuvering Time

Maneuvering time is the time required by drivers to perform an intersecting maneuver at low relative speed. It includes the time required by drivers to select a gap in the moving stream which they wish to enter or cross and to use that gap without speed interference. During the maneuvering time, a merging and crossing driver must anticipate the time of his arrival at the collision point so as to reach the point simultaneously with a gap between vehicles in the other flow that will permit his safe entrance into or across that flow. He must pace the speed of the other flow and accelerate or decelerate so as to enter the gap without hazardous interference.

In the case of diverging, maneuvering time is the time required for drivers to decelerate to the speed of intersection exit curves *after completing* the maneuver so as not to reduce speed while within the combined flow. Maneuvering time requirements at elemental merging and crossing maneuver areas become greater with increased traffic volumes. As volumes increase, fewer and shorter gaps occur in the intersecting flows. Insufficient maneuvering time causes slow downs and stops as drivers fail to adjust their speed and time of arrival at the maneuver point to conform with acceptable gaps. Maneuver areas then become congested and operate at *high* relative speed until a reduction in volume permits traffic to again become fluid.

Figure 3 shows the availability of acceptable gaps for merging and crossing in terms of relative speed and various volumes of traffic in the intersected flow. The per cent of time shown during which intersecting maneuvers are possible takes into consideration the fact that longer gaps are required with increased relative speed. The time available for maneuvers at low relative speed may be used efficiently only when maneuvering time is adequate. Maneuvering time may be provided through intersection sight distance or design afford-

FIGURE 3. Availability of Acceptable Gaps for Merging and Crossing at Elemental Maneuver Areas.



NOTE: Percentages taken from "Studies of Weaving and Merging Traffic, A Symposium," Bureau of Highway Traffic, Yale University, Technical Report Number 4, 1948. Figure Number 1, page 4.

Low relative speed conditions based upon 2 second gap acceptance and high relative speed conditions upon 6 second gap acceptance, ibid, pages 69 and 70.

ing flexibility in the place of maneuver, or both. These two methods of providing maneuvering time through design are illustrated by Figure 4.

Elemental Merging and Diverging Maneuvers

Small angles of intersection are inherent in elemental merging and diverging maneuvers. Relative speed at elemental merging and diverging maneuver areas is contingent *only* upon difference in

speed of the intersecting vehicles. Creation of an operating environment for *low relative speed* at these maneuver areas calls for balanced speed design in the cross section and alignment of maneuver area channels.

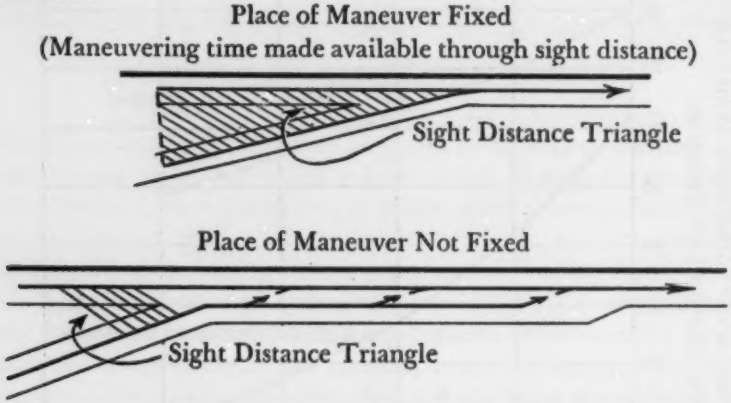

Place of Maneuver Fixed
(Maneuvering time made available through sight distance)
Sight Distance Triangle
Place of Maneuver Not Fixed
Sight Distance Triangle

FIGURE 4. Two Methods of Providing Maneuvering Time through the Design of Elemental Maneuver Areas.

Stop signs and traffic signals should normally be avoided at elemental merging and diverging maneuver areas where design may accommodate maneuvers at low relative speed. Where pedestrian or other conflicts extraneous to the elemental merging or diverging maneuver cause flow interruption and hazard, traffic controls may be required for safety at the sacrifice of low relative speed. The speed differentials thus produced greatly reduce maneuver area operational efficiency.

Elemental Crossing Maneuver Areas

Crossing flows are independent of each other. Thus, they may be grade-separated. Intersectional regulations and controls are not necessary at grade-separated crossings because there is no conflict between flows. Only crossing flows may be grade-separated. Crossing flows may intersect at any angle. Crossing at *low relative speed* may be performed only when the maneuver area is designed for a small angle of intersection.

Large angles of crossing between flows operating at the same grade produce high relative speed conditions which are inherently *unsafe*. Traffic at such crossings must nearly always be controlled by stop signs or traffic signals to provide an acceptable level of safety.

FIGURE 5. Three Types of Elemental Crossing Maneuver Areas.

The crossing of traffic flows may also be accommodated by weaving. Weaving is the combination of merging and diverging maneuvers so vehicle paths may cross obliquely at low relative speed. By weaving, vehicle flows may cross at low relative speed with a high degree of safety.

Thus, there are three design and accompanying operational possibilities to be utilized in the design of elemental crossing maneuver areas. These are: (a) grade-separation—requiring no traffic control and eliminating the crossing conflict, (b) weaving—requiring no traffic control and operating at low relative speed, and (c) direct crossing at grade—requiring traffic control for safety when large angles are involved. Figure 5 illustrates these three types of elemental maneuver areas.

Capacities of Elemental Maneuver Areas

The capacity of elemental grade-separated maneuver areas is equal to the combined capacities of the two crossing lanes. The capacity of elemental merging and grade crossing maneuver areas depends on relative speed. When relative speed is high, the maximum possi-

ble capacity of elemental maneuver areas at grade is 1,200 to 1,500 passenger vehicles per hour. This is the maximum capacity of a traffic signal or police officer controlled elemental maneuver area with a backlog of traffic on both approaches. It is also the capacity of an uncontrolled elemental maneuver area where insufficient maneuvering time causes stop and go operations.

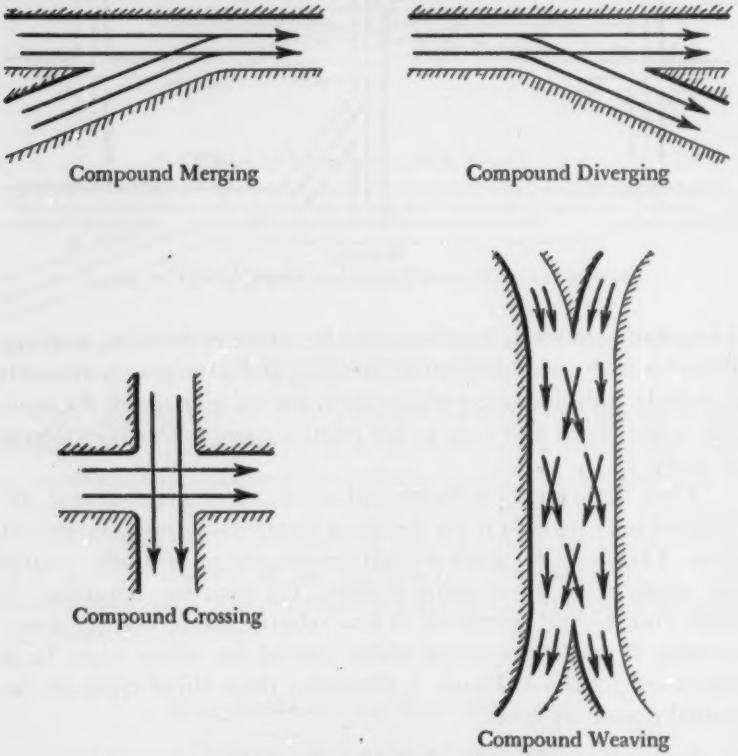


FIGURE 6. Compound Maneuver Areas.

As relative speed decreases the capacity of elemental maneuver areas increase. Their maximum capacity approaches 2,000 to 2,200 passenger vehicles per hour when vehicles intersect at low relative speed and maneuvering time is adequate. This is the maximum capacity of a single traffic lane. Interference caused by parking, pedes-

trians, buses, etc., as well as trucks in the traffic flow will reduce these capacities.

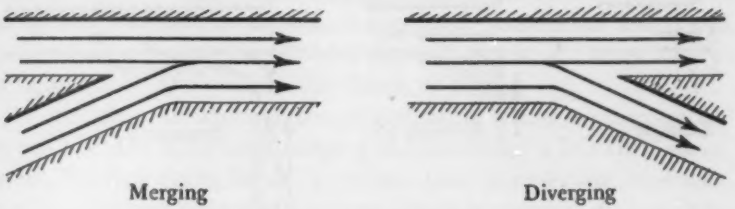


FIGURE 7. Elemental Design for Two Lane Turns.

Compound Maneuver Areas

Elemental maneuver areas accommodating single lane flows are simplest in operation. Maneuver areas of multi-lane flows offer higher capacities but are more complex in operation than elemental maneuver areas. Figure 6 illustrates the several types of compound maneuver areas. The disadvantages of the additional crossing conflicts which occur with compound maneuver area operations offset increased capacity advantages, except where grade separation or traffic signal control is employed to eliminate or control these conflicts.

Where the volume of turning traffic is greater than may be efficiently accommodated by an elemental maneuver area, extra lanes are required as illustrated by Figure 7.

Separation of Maneuver Areas

The overlapping influences of groups of maneuver areas may reduce the efficiency of intersectional operations. Drivers may best cope with traffic situations when they occur one-at-a-time. For maneuvers performed at low relative speed, there must be sufficient time for drivers to make adjustments in speed and path to conform with the time-space requirements of each flow to be crossed or entered. Furthermore, when maneuver areas coincide or are closely adjacent to each other their capacities are seriously reduced.

Figure 8 illustrates the influence of maneuver areas on each other. In example a, the radius of turn is too short to permit merging and

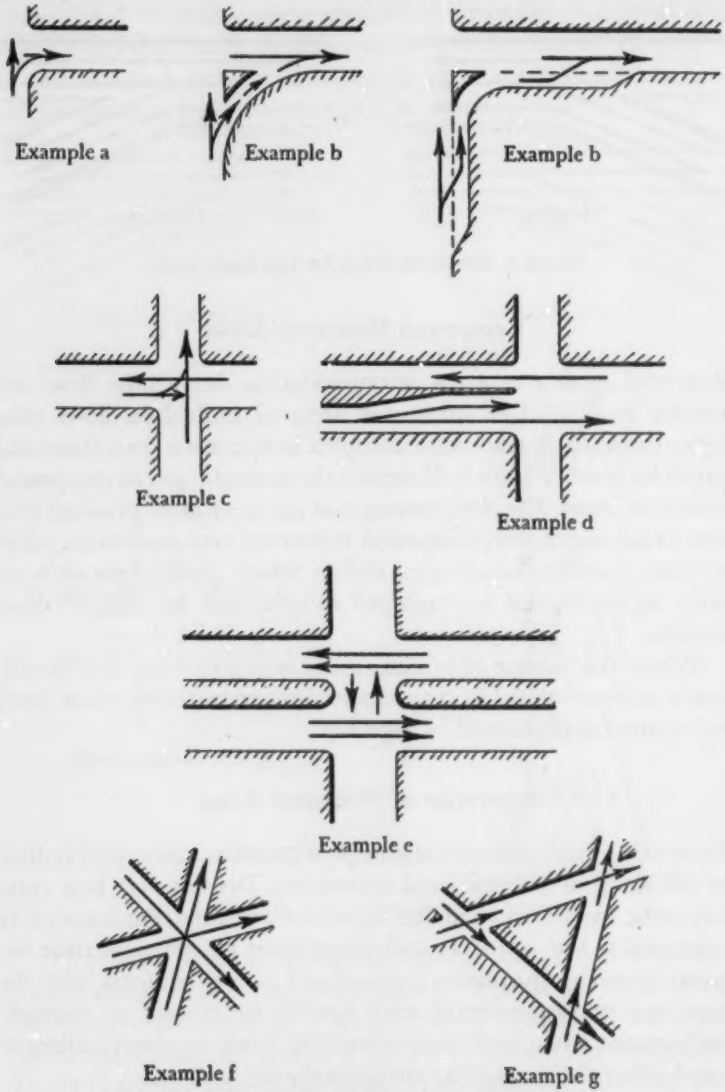


FIGURE 8. Examples of the Separation of Maneuver Areas.

diverging at low relative speed. With the radius shown, centrifugal force limits the speed of divergence and sufficient distance is not available for drivers to make adjustments in the time and speed of mergence. Example b shows how increased distance for speed and space adjustments may be afforded through the use of a longer radius or acceleration and deceleration lanes, or both.

Example c, of figure 8, shows a crossing conflict occurring between the diverging and merging maneuvers of a left turn movement. While waiting for an opportune time to enter the cross flow, the left turn may delay the flow from which it wishes to diverge. The left turn lane shown by example d provides a "shadowed" deceleration and storage lane to accommodate the diverging maneuver at low relative speed.

Example e provides a "shadowed" storage area for crossing traffic. Example f shows maneuver areas imposed one on top of the other. Since all three flows shown by this example must use a common intersectional area, the volume accommodation is much less than that of example g.

Substitution and Arrangement of Maneuver Areas

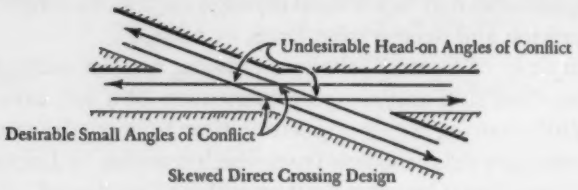
Intersection designers may substitute grade separation, weaving or direct crossing for each other when providing for crossing flows. Most intersection approaches carry two-way traffic movement. When direct crossings accommodate two-way traffic, a small intersecting angle with the crossing flow from one direction creates a *large complementary* angle of intersection with the other direction flow. The geometry involved is shown by Figure 9. For two way flows, large maneuver angles create undesirable operating conditions which nullify the advantages of the complementing small intersecting angle. Experience has shown that direct crossings at grade which accommodate two way flows should always be designed at right angles.

Low relative speed crossing accommodation for two way flows is possible only with rotary type intersection design. Figure 9 also illustrates the elimination of large intersecting angles between two way crossing flows by rotary design.

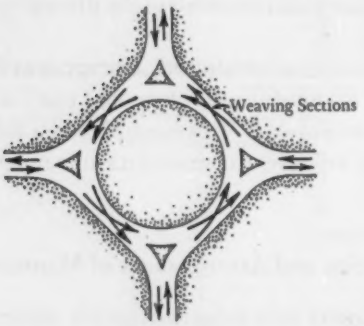
No substitutions may be made for the merging and diverging maneuvers accompanying a turning movement at an intersection.

There is, however, a choice in the arrangement of maneuver areas to provide for turns.

In countries where traffic "keeps to the right" right turns are direct and unhampered by other crossing flows. Maneuver areas for



Skewed Direct Crossing Design



Rotary Design

FIGURE 9. Geometry of Two Way Crossings at Grade.

right turns are nearly always arranged as shown by Figure 10. The *left turn* paths of vehicles are usually crossed by other flows. Figure 10 shows the most frequently used arrangements of maneuver areas to provide for left turns. Left turns often cause the most trouble in intersection design.

Intersection Types

Substitutions, separations, and arrangements of maneuver areas have produced a series of intersection design types. These types listed in the order of increasing probable construction cost and decreased intersection delay incurred by drivers are as follows:

1. Common intersection—stop signs or signals required; all maneuvers performed at high relative speed.

2. Channelized intersection—stop signs or signals required to control crossing flows; some or all merging and diverging maneuvers accommodated at low relative speed.

3. Rotary intersections—no regulatory control required; all movements weave at low relative speed.

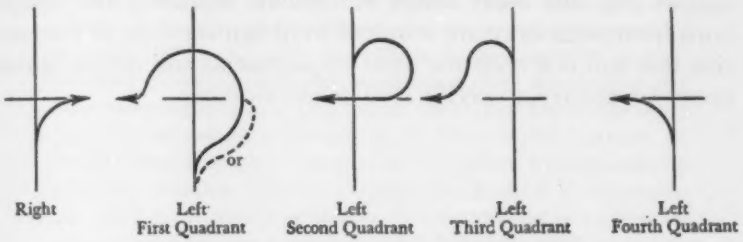


FIGURE 10. Maneuver Area Arrangements for Turns.

4. Grade separated intersections—no regulatory control; crossing maneuvers separated; all turning movements preferably merge and diverge at low relative speed.

The capacity of each intersection depends upon the nature of its traffic control, relative speed, maneuvering time, number of lanes and other factors previously discussed. Sub-types of intersections combining the features of the four types listed are frequently used and design forms vary with the number of approaches and approaches carrying two or one way flows.

Limitations in Intersection Design

The demands imposed by traffic vary widely at different intersections. The number of vehicles, sizes and weights of vehicles and their speeds all affect the design and regulatory control of intersections. Pedestrians, parking, transit loading and other ancillary intersectional services must also be considered.

Limiting factors in design are physical, economic and political. Physical limitations take the form of natural and man-made barriers at intersection sites which limit areas for intersectional use. Eco-

nomic factors include costs of construction and maintenance, the availability of highway funds and benefit-cost ratios.

It has been shown that the quality of traffic accommodation at intersections may be produced in various degrees through design, regulation and control. Intersections should not be accident prone or become unduly congested at frequent intervals, but there are degrees of safety, congestion, comfort and convenience to be weighed against costs and other design limitations. Ingenuity and insight born from experience are required to design the type of intersection that will best meet the traffic requirements and design limitations encountered at specific intersection locations.

Providing for Automotive Services in Urban Land Development

SEWARD H. MOTT AND BUFORD HAYDEN

Mr. Mott has for thirty years been specializing in community planning, site selection and the development of site plans for commercial, industrial, and institutional projects. For eight years he was national director of the Land Planning Division of the Federal Housing Administration and established their subdivision and land planning standards throughout the United States. For seven years he was executive director of the Urban Land Institute. In England and European countries he has studied housing and city planning activities. His list of clients and projects is impressive. Mr. Mott is the author of articles, books, technical pamphlets on developing, planning subdivisions and shopping centers, including the Community Builders Handbook published by the Urban Land Institute. He is a member of the American Institute of Planners, and a registered Professional Engineer in Washington, D. C.

Mr. Hayden served as an aircraft engineer in the United States Navy for five years. Later he was Land Design Engineer for the Maryland-National Capital Park and Planning Commission at Silver Spring, Md. He then joined Seward H. Mott Associates. He has served as a consultant on traffic and land planning problems for consulting firms in Baltimore, Md., St. Louis, Mo., and for the Baltimore County Highway Department at Towson, Md.

THE original street pattern of a high percentage of our cities took no cognizance of the magnitude and type of traffic load that abutting land uses would create. Streets of equal width were laid out in an even grid. The frontage was used for whatever purpose the buyer thought profitable. New York, Philadelphia, New Orleans, were early examples. Later, as the midwest opened up, towns were laid out in comparable grids following the north-south and east-west section lines.

As the towns grew, a natural selection of various land uses took place: Industry was attracted to water frontage or valley bottoms where railroads and state turnpikes took advantage of the level

grades—here facilities for transporting heavy goods were available, and power sources were at hand.

Commercial areas gradually took form, usually at the intersection of two streets that served the hinterland. At such locations, retail commercial structures mushroomed and a central business district was formed.

Bit by bit, the residential areas fell into a pattern. Wealthy merchants and bankers moved a few blocks outside the commercial centers, away from the smoke and noise of industry; and Rittenhouse Square, Upper Fifth Avenue, and Nob Hill came into existence. Laborers' homes clustered within walking distance of their jobs. When the commercial center expanded, the well-to-do moved farther out but always in the same general direction in which they started, as shown by studies of city structure by Dr. Homer Hoyt.

With the advent of the automobile and the rapid shift of population from rural to urban areas, haphazard, uncontrolled land uses not only seriously affected established land values; the horse-and-buggy street pattern was wholly inadequate for the complex traffic needs. The major problems of the city planner shifted from the field of esthetics to that of economics. New communities and additions to the urban areas are now being planned with street systems that take into account the character and magnitude of the traffic generated by the various land uses proposed. In this field, the city planner and the highway and traffic engineer must work closely together.

Land Planning and Traffic Engineering

To secure efficient and proper use of the land in urban development today, it is necessary to move people and goods to and from and through industrial, commercial, residential and recreational areas, safely and quickly. The following methods of transportation are available: train, plane, boat, automobile, and truck.

Urban congestion due to trains, planes, or boats is minor. Problems of expansion relative to these transportation facilities are straightforward and simple compared with the rapidly stretching "octopus" of automobile traffic congestion, constantly threatening to blight or choke off areas of our cities.

With vehicular miles of travel leaping ahead in all areas of the United States, it becomes more and more apparent that the automobile is the single most important factor in shaping and reshaping community and urban development. In other words, a convenient, economic and far-sighted traffic circulation plan is the most important factor in developing a sound urban plan. Consequently, the community planner must either have considerable traffic engineering experience or call in a traffic engineer.

Just as the land planner has begun to accept and lean on the traffic engineer, the converse is also true. The traffic engineer's single most perplexing question is what to do with the peak load traffic. In most traffic congestion problems, if the peak load could be spread over a longer period, or the peak load traffic dispersed over several routes rather than concentrated on a few, the problem would be solved. The land planner has direct control, to a degree, over this peak load problem by determining the size and location of land uses.

A good traffic circulation plan means not only streets of sufficient width, minimum grade and safe sight distance, but also means:

(1) An integrated mass transportation system and plan

(2) An integrated off-street parking plan providing terminal facilities for the various types of vehicular traffic

(3) An integrated off-street servicing and loading plan in areas where such facilities are needed

Item (1) above concerns itself with all the common industrial, commercial and residential land uses. Item (2) is primarily concerned with commercial or so-called service land uses, and Item (3) is primarily a problem of both commercial and industrial land uses. Development of these plans still does not solve the traffic circulation problem unless the plans are well integrated and, most particularly, integrated with the various land uses within the urban community.

The planner must pay more and more attention in the design of the pattern of his various land uses, to the vehicular traffic problem relative to that particular land use, and how the traffic generated by

that development affects the surrounding land uses, traffic pattern and vice versa.

Traffic Characteristics of Urban Land Uses

In planning for the more common urban land uses, some of the traffic characteristics we generally consider, and the land use treatments and standards required by us due to these traffic characteristics, are discussed below.

A. *Industrial Land Uses:* The common general interpretation of industrial land uses are businesses that manufacture a product, most particularly those which, in the process of making the product, perform in a manner offensive to the eye, ear or nose of most people. In the exploitation of this land use, the traffic that serves it generally has the following characteristics:

1. There is a heavy peak load of passenger cars bringing large numbers of employees to and from the place of employment at starting and quitting time. This traffic generally moves or desires to move at relatively high city speeds, say 30 to 40 miles per hour, because most of these vehicles come from some distance.

2. This heavy peak load of passenger vehicles must be parked somewhere close to the point of employment.

3. There is a heavy concentration of large truck traffic. This traffic is slow and noisy, much of it moving at night and offensive to the nose and sight in some cases. Some trucks have excessive weight loads; some are above standard width.

4. At its terminus, this truck traffic must park and unload.

In developing raw land for industrial purposes, all of the elements necessary for estimating vehicular traffic needs—number of employees, number and size of trucks, kind of unloading facilities required—are generally available. An industrial location is frequently beyond the economic range of mass transportation and therefore the volume of employee vehicles varies directly as the distance from the mass transportation increases, unless the industry provides transportation for its employees. If this is the case, the

land values will usually be low enough to permit ample off-street parking and off-street loading.

Thus most of the evils of the traffic characteristics of industrial land uses can be reduced to a minimum by locating land uses on the periphery of the urban area near the railroad or navigable waterways, and if possible, close to the main interregional highways. Thereby we also reduce the mixing of industrial and passenger traffic to a minimum.

With land centrally located in a large city, the problem is more difficult. The traffic characteristics are more variable. They can, however, be discerned by consulting with local highway and traffic authorities, or if necessary, proper traffic surveys can be conducted. These surveys might indicate that the traffic difficulties for the proposed land use are so expensive to overcome that the site is uneconomical to develop. It is also a possibility that even though the proposed site is economical to develop, the absence of proper regulations enforcing off-street parking and loading would permit development of adjoining property which would eventually be detrimental. Zoning and land covenants should not permit such development.

B. Commercial Land Uses: The common general acceptance of the commercial uses of land are those businesses which sell something in the way of a product or service. In the exploitation of this land use, the traffic generated commonly has the following characteristics:

1. Such a land use normally generates the greatest traffic density of our common land uses.

2. All of these vehicles want to park one or more times for short intervals. Therefore, traffic within the commercial area is slow and the attention of the driver is divided. (a) The majority of the vehicles are customer-driven (women) and convenience and ease of parking facilities is most desirable. (b) This parking problem due to its volume also creates an ingress and egress problem to and from the traffic arteries. Unless smooth uninterrupted ingress and egress to the main traffic arteries is provided, there will be a back-up on the traffic artery thereby creating a serious traffic bottleneck.

3. These commercial uses also require facilities for delivery service, both to and from the area. This alone generates a considerable volume of small and large truck traffic.

Those traffic characteristics have forced a partial solution that generally has been a dispersal of some of the commercial uses to a closer proximity to the customer—better known as the shopping center. In a modern shopping center, the traffic is solved by not only providing sufficient every-day peak load parking but by providing separate areas for employee parking and additional overflow parking for holiday periods.

The unloading and servicing problem is taken care of by providing off-street service drives and unloading docks that in most cases are screened, not only from the adjoining land uses, but even from abutting customer parking. In all cases, an attempt is made to separate the service traffic from the customer passenger traffic and effort is made to limit heavy truck delivery to off-hours.

A successful shopping center will induce additional traffic on adjoining approaching streets. This situation must not be sidestepped. However, elements for estimating the needed capacities are not difficult to obtain. Due to this fact, it is generally good planning to locate said shopping center land uses close to one or more main traffic arteries, not only to move the increased traffic efficiently, but also to avoid the use of strictly residential streets for commercial traffic and thereby decrease residential values.

Even though the dispersal of certain commercial land uses has done much to relieve the density of traffic in the central business district, complete dispersal or the dissolving of the central business district is not recommended. There are certain types of business for which a central location is still important. These are government offices of all levels, main offices of banks, main sales offices and big stores that carry a large variety or complete line of merchandise.

If the commercial use is to be developed in an already existing large central business district, again the problem has ramifications. The characteristics of the traffic are quite similar to those mentioned above, but the traffic volumes are greater so that problems of off-street parking and unloading become more intensive and solutions

NOTE: Such a treatment of ingress and egress is possible for a shopping center with approximately

NOTE: Such a treatment of ingress and egress is possible for a shopping center with approximately 3,000-car parking capacity and medium to low peak-hour traffic volumes on the major highways. For centers with greater parking capacity, it would probably be necessary and economical to have a grade separation to eliminate left-turning movements.

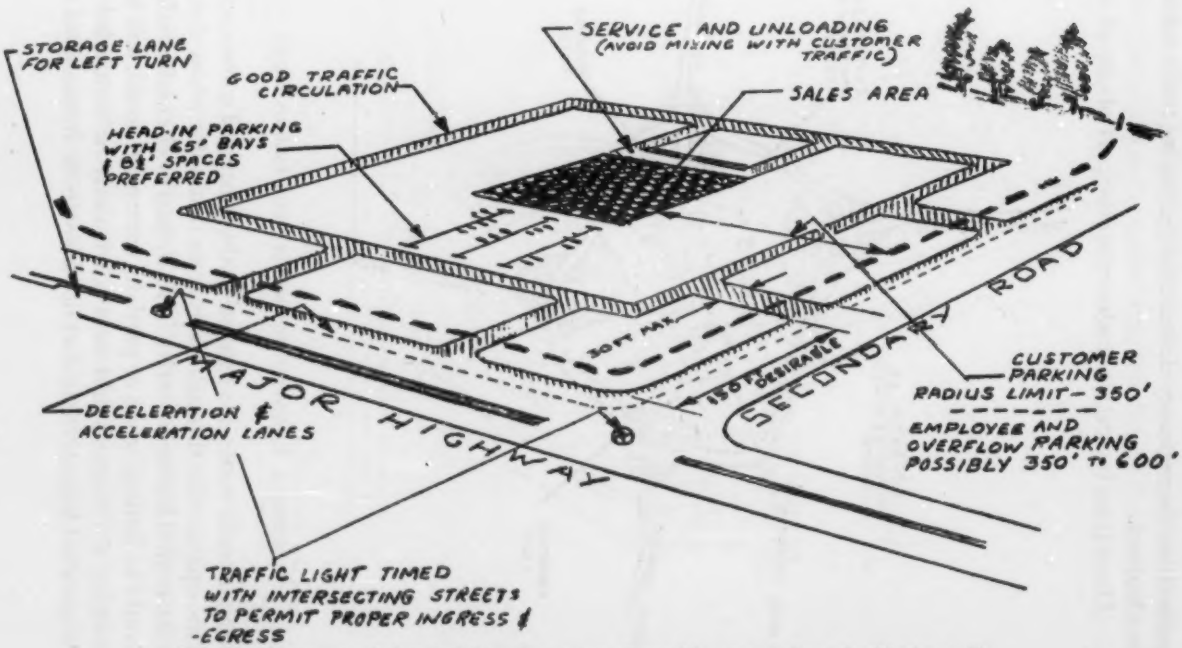

STORAGE LANE FOR LEFT TURN
GOOD TRAFFIC CIRCULATION
SERVICE AND UNLOADING (AVOID MIXING WITH CUSTOMER TRAFFIC)
SALES AREA
HEAD-IN PARKING WITH 65' BAYS (18' SPACES PREFERRED
30FT MIN.
150FT. DESIRABLE
SECONDARY ROAD
CUSTOMER PARKING RADIUS LIMIT - 350'
EMPLOYEE AND OVERFLOW PARKING POSSIBLY 350' TO 600'
MAJOR HIGHWAY
DECELERATION & ACCELERATION LANES
TRAFFIC LIGHT TIMED WITH INTERSECTING STREETS TO PERMIT PROPER INGRESS & EGRESS

FIGURE 1. Recommended typical shopping center planned for smooth flow of vehicular traffic.

are more expensive. Again with proper coordination with local authorities, the necessary elements for estimating traffic volumes can be obtained.

There is an increasing tendency on the part of city planners to

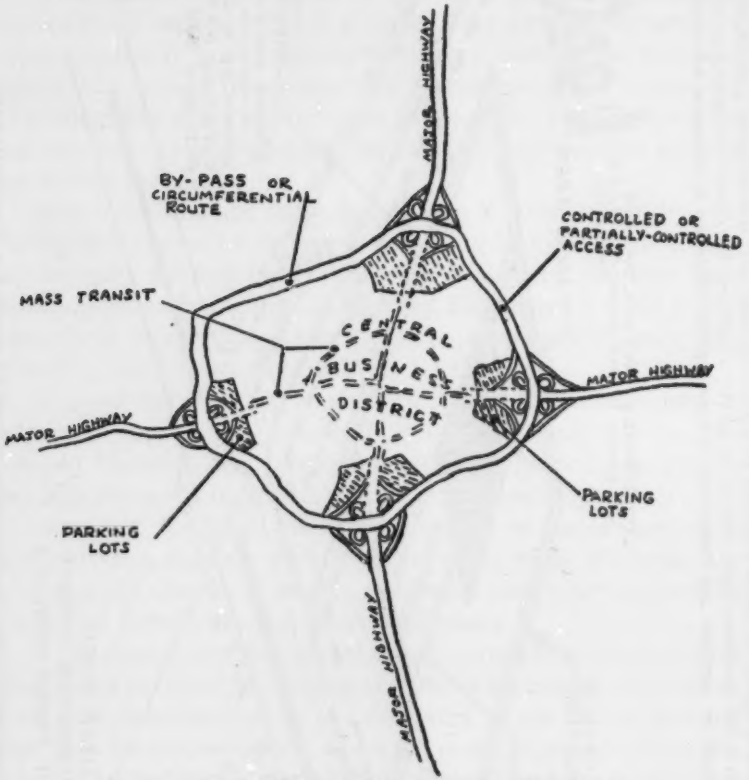


FIGURE 2. Typical plan for relief of central business district.

provide traffic routes for by-passing the congested commercial area. This separates the through-traffic from that traffic whose destination is the central business district. This by-pass or circumferential route should be limited access or partially controlled access, and land use abutting the route should most particularly be controlled so that the so-called by-pass route does not become the future main drag.

To prevent additional vehicles from entering the central business district it has also proved economically feasible to place parking lots on the periphery of the central business district close to points of access to the aforementioned circumferential route and also close to

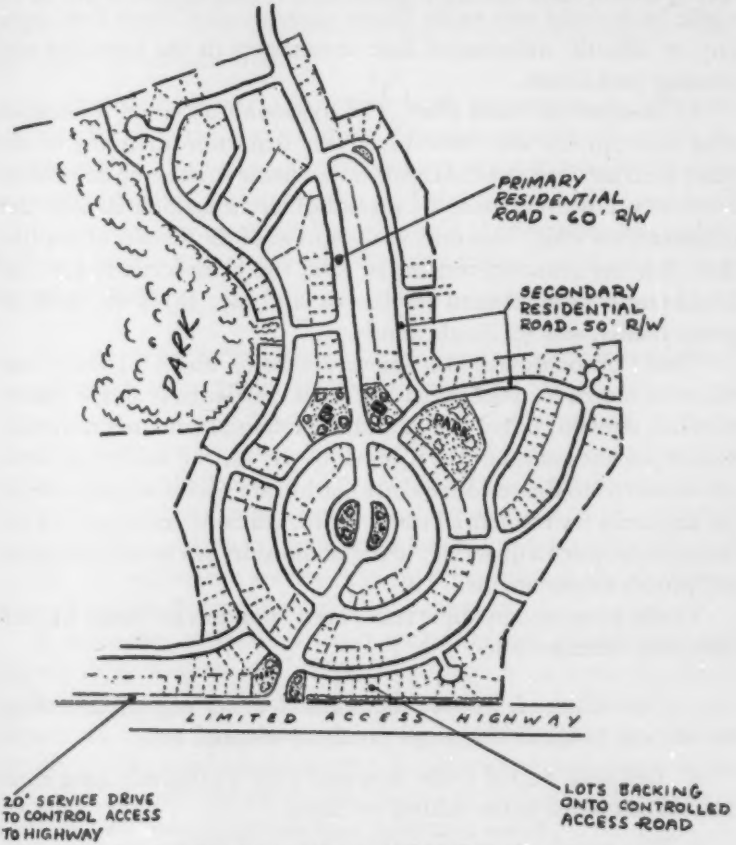

PRIMARY RESIDENTIAL ROAD - 60' R/W
SECONDARY RESIDENTIAL ROAD - 50' R/W
PARK
PARK
LIMITED ACCESS HIGHWAY
20' SERVICE DRIVE TO CONTROL ACCESS TO HIGHWAY
LOTS BACKING ONTO CONTROLLED ACCESS ROAD

FIGURE 3. Typical good subdivision plan.

and coordinated with the mass transportation system of the central business district.

Noting previous traffic characteristics, it is generally good planning to locate the commercial land uses central to population den-

sity, considering that the customers and service people must have convenient access to same. It is also generally desirable not to place commercial land uses too close to the industrial land uses because both land uses generate high peak traffic loads. These high peak traffic loads could very easily dictate uneconomical street lane capacity or difficult, unbalanced lane movements in the morning and evening peak hours.

C. *Residential Land Uses:* The commonly accepted residential land uses provide less controversy over definition than any of the other land uses because the classification name itself is the definition. Generally, however, there are several different residential land use classifications which vary only in the spread of the density of population. But the common residential land use classifications are: (a) Multi-family or apartment residential land use; (b) Two, three or group family, and (c) Single family.

There probably has been more discussion about highway and street standards for residential land uses, particularly single family land use, than any other uses. Because residential land uses normally do not provide sufficient tax revenue to pay for the municipal services rendered to the residential area, arbitrary excessive and inflexible standards for residential street width, gradient and construction can prove as much a disservice to the community as a lack of adequate and proper requirements.

Traffic generated by these residential land uses normally has the following characteristics:

1. The volume is low—to the point of being negligible during the off-peak hours in the single-family residential area.

2. The peak period traffic is spread over a relatively long time interval compared to the volume involved.

3. The speeds are comparatively low and drivers are comparatively alert and safety conscious due to the fact that most of the drivers are in their own neighborhoods and conscious of children.

4. Traffic origin and destination is very diversified, therefore the density of traffic within a specified residential area depends very much on the design of the subdivision.

5. Pedestrian traffic is rather light compared to the other land uses and sight distances due to adjoining building setbacks are generally comparatively good.

6. On-street parking is generally permitted on both sides of the residential street thereby providing only one moving lane in most secondary residential streets.

7. The multi-family residential land uses naturally generate more traffic than the single family. The volume of traffic varies directly with the size and population density of the development. Also normally off-street parking is provided according to FHA and local zoning regulations, or generally at the ratio of one space (300 square feet) per family unit. Some servicing and unloading facilities must be provided also.

The previous traffic characteristics for single-family residential use generally dictate low street standards for width, gradient and construction. Construction standards on secondary and primary residential streets are more generally dictated by weather characteristics than by traffic volumes. The secondary residential street standard width, alignment and pattern are dictated more by the necessity of providing satisfactory traffic circulation for fire protection and health and ambulance service than by the normal traffic characteristics of the single-family residential land uses.

A secondary residential street with fifty-foot right-of-way and twenty-six foot pavement width is satisfactory to meet the above traffic characteristics. Where approximately 300 single-family residences are served by a residential street, a peak hour volume of 100 to 150 vehicles would be generated. It is therefore desirable to designate such a street a primary residential street and provide a sixty-foot right-of-way and a thirty-six foot pavement width.

Four-foot sidewalks should be provided at least seven feet off the face of the pavement curb on all primary residential streets. The necessity and feasibility for sidewalks on secondary residential streets depend on the topography, lot width and character of the development. The need for sidewalks on secondary residential streets has been eliminated in some residential developments by requiring off-

street parking in single-family areas. It has also been found that it is less expensive to provide off-street parking on some primary residential streets and reserve the streets for moving traffic.

The large volumes of fast-moving traffic created in recent years have developed the controlled access and partially controlled access highways. These highways have directly influenced residential layout. In the recent past, lots formerly fronted on main highways. Now, in order to provide a safer access into high speed moving lanes and prevent interruption of traffic flow, direct individual lot access to many highways is prevented. This is done in various ways in the planning of the subdivision.

One method is to provide sufficient right-of-way on the highway for a twenty-foot service frontage road. A variation of this method is to provide the service road or access alley to the rear of the lots fronting on the controlled access road. This must be handled carefully, however, or the impression is created that residential access is provided by an alley. In general, the most satisfactory treatment is to back the lots onto the controlled access highway, providing sufficient backyard for screen planting and insulation from the traffic on the highway.

Traffic generated by multi-family residential land uses will depend on the size and population density of the development. However, all streets adjoining or through such uses should have minimum right-of-way widths of sixty feet and pavements thirty-six feet wide with five-foot sidewalks provided.

Considering the above traffic characteristics relative to residential land uses, it seems logical to locate these uses as close as it is possible to the employment and everyday shopping land ues. This is particularly true for the multi-family residential uses. Such locations prevent excessive extension of municipal services including highways. Multi-family residential uses should be located adjacent or close to main highways. However, main highways should not be deliberately planned through residential land uses and if they are, the residential uses should be screened from the highway by parks and other land uses as effectively as possible.

The three common land uses have distinct vehicular traffic characteristics. These traffic characteristics are one of the primary,

if not the single, most important factors in shaping urban land use patterns today. There are basic land use concepts that are known to the traffic engineer and there are basic traffic engineering patterns and ideas that are used every day by the land planner. The proper future use of urban lands depends upon more and better cooperation between the land planner and the traffic engineer. No matter how perfect the plan for land use and traffic circulation, there must also be proper control of the existing and future land uses in a community. These controls, which are zoning regulations and proper tax assessing, are in the hands of the tax-paying public. This is a safe and proper place.

Fog on the New Jersey Turnpike

EDMUND R. RICKER

Mr. Ricker has been traffic engineer for the New Jersey Turnpike Authority since 1950. Previously he was for two years traffic engineer of New Haven, Connecticut. He is a member of the Institute of Traffic Engineers' Technical Council and head of Department 6, Planning and Geometric Design of Terminal Facilities; he is also president of the New York Metropolitan Section of ITE. He is associate editor of "Traffic Engineering" magazine and author of "The Traffic Design of Parking Garages" published by the Eno Foundation in 1948. An article by Mr. Ricker, "Evaluation of Off-street Parking in Terms of Operating Time," appeared in the January, 1948 Traffic Quarterly.

FOG has caused numerous multiple-vehicle accidents on highways all over the nation, and accidents on the New Jersey Turnpike under severe fog conditions have resulted in a reappraisal of the relationship between highway traffic movements and atmospheric conditions. Previously, fogs, though recognized as definitely hazardous, had been considered a natural phenomenon to be talked about, like darkness or heavy rain, but not as an operational problem that must be attacked by highway officials.

The location of the Turnpike, through low-lying lands bordering the seacoast, is particularly susceptible to fogs. Although this fact was recognized during the design of the Turnpike, the location was dictated by the heavy traffic demands of the corridor in which it was built. There are many days each year when the older highways in this area are completely blanketed by fog, and multiple rear-end collisions are all too frequent; a similar situation was bound to exist on the Turnpike.

Analysis of Fog Accidents

From time of opening the Turnpike to traffic, a careful record was kept of all types of accidents. A summary of accidents occurring during foggy weather, made early in the fall of 1952, failed to disclose any particular pattern and no direct correlation between the locations and times of occurrence of such accidents and the foggy areas

observed and reported by the state police. Suddenly there occurred a series of accidents, most of which were concentrated in a two-mile stretch north of Elizabeth. During the period between November 3 and November 15, 1952 there were eighteen accidents during foggy weather, eight of which happened between Milepost 100 and Milepost 103. On the other hand, two of the worst fog accidents, involving sixteen vehicles and five injuries and four vehicles and two fatalities respectively, happened almost simultaneously on opposite sides of the Turnpike at Milepost 110, where there is no record of fog-accident experience, either before or since.

During 1952, forty-two accidents occurred during weather reported as "fog" by the state police, out of a total of 713 accidents reported by them. Of these, many probably would have happened regardless of weather, as they involved mechanical or driver failures not directly related to the fog. In addition, the standard method of accident reporting does not indicate the severity of adverse weather conditions, nor the part it played in causing the accident. Nevertheless, there were a number of similar accidents, involving six fatalities, which were directly traceable to fog.

The Turnpike Authority, because of these facts, directed an immediate investigation of all known methods of alleviating fog conditions and the development of a complete safety program to minimize the operational difficulties of highway travel in adverse weather. The problem of keeping an express highway in operation during extreme fog conditions must be tackled, regardless of past or present policies in regard to other highways. This article is a progress report on this program, which has by no means reached a final, or even a completely satisfactory, answer. Three general phases of the program are described: dispersal of the fog, guiding devices to lead motorists through it, and methods of closely controlling traffic to minimize hazards. Each is being followed, as well as a meteorological study which will result in the assembly of much more detailed data as to type, frequency and location of fog on the Turnpike.

Fog Dispersal

The dispersal of fog is undoubtedly the most desirable end, and one which has received much attention by the Armed Forces. The

publicity connected with FIDO and other similar devices World War II would seem to indicate that this method could be directly applied to highway problems. Closer investigation, however, indicates otherwise. The expense of placing and operating a high-pressure gas or oil system over the many miles of foggy areas on the Turnpike is almost completely prohibitive; in addition, the prospect of motorists otherwise unfamiliar with such devices, operating between two blazing infernos might seem worse than the more-familiar fog. There are other potential methods of dissipating fogs, including radiant heat, chemical and electrical means. While none appears immediately practical, close liaison is being maintained with the U. S. Navy and several universities which are now conducting research on these matters.

Guiding Devices

Many guiding devices have been suggested. Some simple ones, such as a continuous white paint line along the inner shoulder are being used. Many others are interesting, and theoretically effective. When applied to conditions existing over many miles of Turnpike, and to thousands of different motorists, with their individual driving experience and vehicles, most devices of this kind raise more difficulties than they can potentially solve.

This may be illustrated by any one of several proposals that would constitute a "block system" such as used by the railroads, to separate physically each vehicle from all others. When applied to the heavy traffic volumes of the Turnpike, even in off-hours, it can be seen that there is neither time nor space available to equip each car with a special device, however simple, and the training of motorists and their acceptance of it pose other problems. Most seriously, it would be dangerous to entrust all motorists' safety to the capacities of some devices, as opposed to the wonderful facilities provided in every driver's head—sight, hearing, perception and reaction, all normal senses used in everyday driving.

Other guiding devices are potentially applicable, and none has been finally rejected. Highway lighting, which was originally included on two major bridges, all interchanges and services areas, is

now being extended. The use of loudspeakers and guide lights placed along the shoulders are others.

Special Control Methods

The immediately available means of providing greater safety under fog conditions lies in more definite and extensive means of traffic control. The principal element is manpower, which generally means police. The Turnpike Detachment has been built up to a total of sixty-five officers and men of the New Jersey State Police. A comprehensive plan is being developed which will make maximum use of this force in fog emergencies, including the extension of shifts to bring in or hold extra forces, the re-assignment of men from adjacent clear areas, and the utilization of maintenance, toll collection and road service personnel. A series of increasingly severe fog conditions are being defined, and procedures established to automatically meet each. It is obvious that these procedures must be modified as additional experience is gained, and that they may be equally adaptable to other emergency conditions such as those arising from national defense.

Every effort is being made to inform the public of the increased traffic control measures. The initial steps were built around a reduction of the speed limit, from sixty to thirty-five miles an hour. Metal plaques, with the number 35 in reflectorized red letters, were attached inconspicuously to the back of the speed limit signs, which are located at five mile intervals, or less. During stormy or foggy periods, these plaques were attached to the front of the sign so as to cover up the numeral 60 and present instead the 35. The toll tickets normally carry a safety message concerned with the sixty-mile speed limit, as well as a variety of others. Special toll tickets are printed and stored at each toll plaza, with messages indicating fog conditions; these are given out to each motorist as he enters the Turnpike. A printed "SPEED LIMIT 35" is placed in the window of each onbound toll booth at these times.

Both of these devices are somewhat routine, not directly spotting the location of extreme hazards. To supplement these, neon signs are being erected at intervals of four to five miles and so located as to

give advance warning of the areas which have proved hazardous in the past. The exact nature of the hazard is spelled out—alternatively "FOG AHEAD," "SNOW—ICE AHEAD," or "ACCIDENT AHEAD," in 10-inch letters, in combination with the words "DRIVE SLOW" in 16-inch letters. The latter part flashes on and off at short intervals. Signs of this type were erected on an emergency procurement basis and placed at each end of the "fog zone" in Elizabeth. All are initially designed for manual operation of the switches, but plans are currently going forward to provide remote control by wire or radio link, so that the police radio dispatcher can immediately place them in operation when the need arises.

It will be noted that the final design of the neon signs does not include any reference to the thirty-five-mile an hour speed limit, as did the experimental signs, and the other devices mentioned above. While thirty-five miles an hour is a quite reasonable speed under certain circumstances, there were found many instances when it was too high or too low, yet the sixty-mile limit was not applicable. The posting of a series of speed limits was carefully considered and rejected, since there did not seem to be any precise means of selecting an absolutely "safe" speed for all drivers, and the many combinations of circumstances possible in 118 miles of travel make the problem of speed limit selection almost hopelessly complex. Hence the present thinking of the Authority is toward a condition of "reduced speed," when the sixty-mile limit is no longer applicable, but each motorist is given responsibility to drive sanely, with full warnings of specific hazards, and arrest for careless driving if he ignores them.

Additional warning devices are under study, including more specific signs at the toll plazas, which may give information as to the extent of the fog area. Electric loudspeakers, either with microphones or canned messages have been made available at the larger interchanges.

The state police are given full responsibility and authority for the safe operation of the Turnpike. They may declare a state of emergency and institute all measures necessary to meet it. Attention is being given to providing them with specially-equipped vehicles for traveling in fog, whether to travel to the aid of motorists or to actually lead them by convoy methods.

Collection of Meteorological Data

A preliminary meteorological study of the Turnpike shows that the fog experience during 1952 may be markedly below the average which can be expected over a period of years. This gives added importance to the programs outlined above, and suggests the need for more detailed meteorological information. Plans are being made to keep detailed records of all visually observed fog, to determine hazardous limits of visibility under Turnpike conditions, and to place recording equipment which will determine the incidence of vision-limiting fogs. Studies also will be made as to the effect of smoke, which is found in combination with the fog at some of the densest spots. The recording equipment, which is essentially a meter for measuring atmospheric transmission, may be later adapted to a fog warning device, giving a remote warning when fog reduces visibility below a certain level.

Summary

Problems caused by fog on densely traveled and high speed highways are not new, nor are they likely to be completely solved in the near future. The New Jersey Turnpike Authority is proceeding to use every possible means to reduce fog hazards and to give motorists every practical safety aid in traversing fog areas. However, the basic responsibility is, and must always be, with the individual driver to operate his vehicle in a safe and proper manner, whether on a country lane or on the latest and best-designed expressway—whether the weather is clear or foggy.

Chicago Attacks Parking Problem

JAMES L. FOLEY JR.

Mr. Foley is a traffic engineer in Baltimore. At the time the article was written, he was Planning Engineer for the Bureau of Street Traffic, City of Chicago, and Acting Head of the newly established Bureau of Parking. Previously he had been traffic engineer for the Chicago Planning Commission, Communications and Anti-Submarine Warfare Officer, U.S.N.R., and junior engineering aide, Traffic Engineering Bureau of the City of Detroit. Mr. Foley is registered as professional engineer, State of Illinois, and is a member of the Institute of Traffic Engineers, American Society of Civil Engineers, Highway Research Board, Western Society of Engineers, American Public Works Association, and American Road Builders Association.

CHICAGO as well as other cities in the country faces an increasingly severe parking problem. The magnitude of the problem is readily apparent to anyone driving on our streets. The problem falls into two basic categories—terminal storage and residential garaging. Both are required to free curb lanes for moving vehicles.

In the last few years, suburban or outlying 'shopping centers' have developed: with their high ratio of parking space to floor area for sales and display, these centers have recognized the desire to shop by car. Existing business areas have millions of dollars invested in facilities which are threatened by this new concept. Tax revenues from existing business districts help support other portions of the city.

Adequate parking in existing shopping centers is necessary to sustain the tax base in the city. Because commercial districts pay more taxes than they require in services, it is in the public interest to promote stable business districts. In Chicago, most business establishments are located along arterial streets with the greatest activity concentrated at the intersection of two or more arterials. This factor complicates the traffic problem by super-imposing high parking activity where the needs of moving traffic are the greatest.

The storage of automobiles in residential areas is considered a

responsibility of the vehicle owner. However, in many of the older residential areas developed prior to the motor age, space is not now available for automobile storage because the development took place when mass transit provided the basic mode of transportation. The automobile changed peoples' habits but the high density residential facilities remain and continue to be occupied. Because of intensive land use, arterial streets and transit lines are closely spaced. It is in these areas that parking relief must be provided if the necessary street capacity is afforded by curb parking controls.

Examination of trends in vehicle registration and gasoline consumption in relation to population growth will emphasize the problem. In the twenties when the population was reaching its peak, the automobile was a luxury. Today after a relatively small population increase, an automobile is almost a necessity.

That the roadways of our arterial streets will be necessary for movement of vehicles rather than parking is shown by an analysis of the combined trends in population vehicle ownership.

Year	*Population*	*Vehicle Registration*
1910	2,185,283	12,926
1920	2,766,815	112,892
1930	3,376,438	466,472
1940	3,396,808	613,597
1950	3,620,962	786,084
1965 (estimate)	3,800,000	

In addition to the traffic generated by city residents, an influx of traffic from outside the city is estimated to exceed 250,000 vehicles daily. Space must be provided for moving and storing these guest cars during their stay.

Significant also is the marked shift in transportation method from mass transit vehicles to private automobiles. This trend is indicated by a comparison of the number of persons entering the central business district by various means of transport from 1931 to 1951.

Year	*Passenger Automobile*	*Streetcar and Bus*	*Elevated and Subway*	*Railroad*
1931	203,916	327,812	191,540	119,742
1936	215,849	293,593	200,212	92,144
1941	251,962	276,655	191,851	103,405
1946	231,201	331,377	229,430	158,001
1951	292,014	231,152	216,288	139,188

It is evident that the automobile has become the largest single method of transportation in the City of Chicago. Outside the central area this trend is even more pronounced because the suburban railroads and rapid transit facilities serve best the heart of the city.

Solving the parking dilemma falls into two stages, immediate relief measures and long range programs. The immediate relief measures are:

1. Parking meter
2. Rush hour parking controls
3. All night parking restrictions.

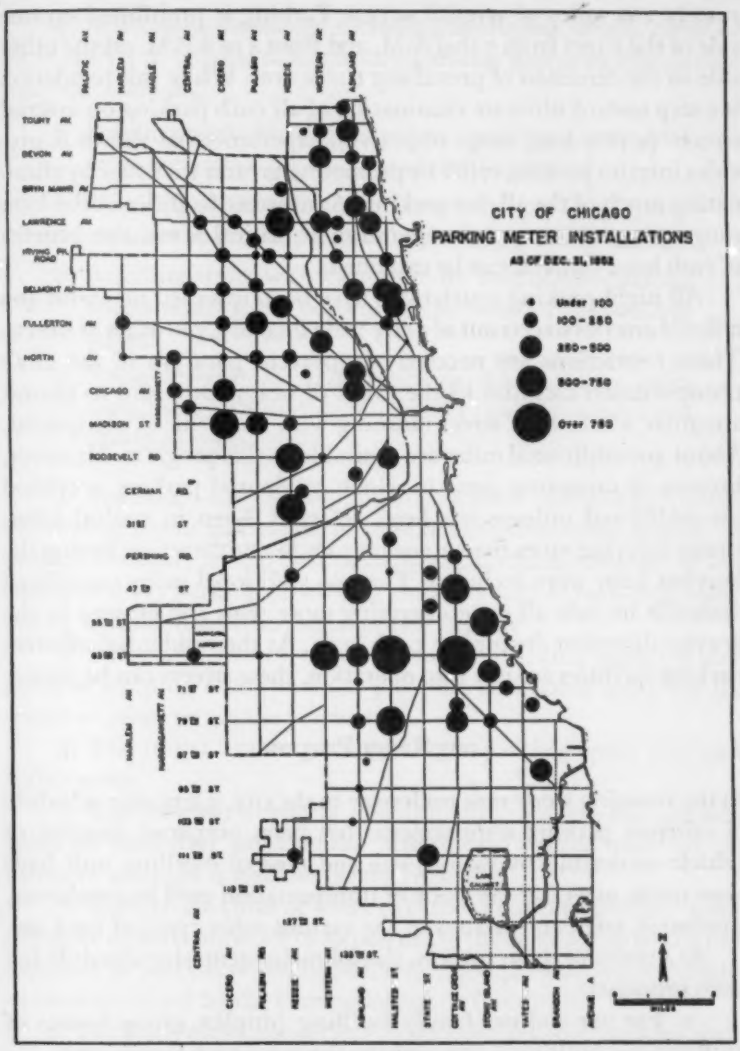
The long range program consists of:

1. Adequate parking requirements in the zoning ordinance.
2. Offstreet parking facilities in existing areas not regulated by zoning.

Immediate Relief Measures

The immediate relief measures support and encourage the long range program by stabilizing its financial base.

Parking meters provide interim relief by increasing turnover, facilitating enforcement, and eliminating or greatly reducing double parking. Chicago now has in operation over 22,000 meters in eighty-eight areas. The number of meters in each area ranges from 30 to 1,000. The accompanying map shows the city-wide coverage of meter areas. At present, all meters are sixty minutes for a nickel or twelve minutes for a penny. After a sufficient experience base has been acquired, some meters may be modified by decreasing or increasing time limit in parts of areas where higher or lower turnover is



warranted and practicable. Of particular importance is the support of meters in the enforcement of rush hour controls.

Rush hour parking controls have been installed on approxi-

mately 200 miles of arterial streets. Parking is prohibited on one side of the street from 7 to 9 A.M. and from 4 to 6 P.M. on the other side in the direction of prevailing traffic flow. While this regulation is a step toward ultimate elimination of all curb parking on arterial streets (a very long range objective), experience has shown it provides interim parking relief by promoting greater turnover by eliminating much of the all day parking. As offstreet facilities in the long range program are put in operation at critical areas, the benefits of rush hour controls can be extended.

All night parking restrictions have been installed on about 400 miles of arterial streets out of a city-wide total of 3,700 miles of streets. These restrictions are necessary to prevent paralysis of the city's transportation facilities in the event of heavy snow and to permit a regular schedule of street cleaning with mechanized equipment. About 300 additional miles are desirable in this program. However, because of numerous areas in which residential parking is critical the additional mileage has been deferred. Even in critical areas, streets carrying more than 2,200 persons in one direction during the heaviest hour were included. The 300 additional miles considered desirable include all streets carrying more than 500 persons in the heavier direction during the peak hour. As the residential offstreet parking facilities are put into operation, these streets can be added.

Long Range Program

In the rezoning study now underway in the city, a tentative schedule of offstreet parking requirements has been prepared. Surveys of vehicle ownership by various size and type of dwelling unit have been made, as well as the mode of transportation used by employees, customers, guests or patrons of the various other types of land use.

As a result of these surveys, the following tentative schedule has been proposed:

1. For one-and two-family dwelling (duplex, group houses or multiple use buildings) one parking space for each family unit.

2. For three-or more-family dwellings (group houses, apartments or multiple use buildings) not over two stories or twenty-five feet in height—one parking space for each family dwelling unit.

3. Apartment buildings, including apartment hotels, three or more stories in height, shall require parking spaces in compliance with the following:

a. Dwelling units with no bedrooms—parking spaces equal to 40 percent of the number of dwelling units.

b. Dwelling units with one bedroom—parking spaces equal to 67 percent of the number of dwelling units.

c. Dwelling units with two or more bedrooms—parking spaces equal to 75 percent of the number of dwelling units.

d. These provisions shall apply to the dwelling units added when a building is altered to provide additional dwelling units.

4. For hotels and clubs—one parking space for each two guests or sleeping rooms and suites, plus such additional space as shall be deemed necessary by the Commissioner of Buildings because of any supplementary parking generating activities such as bars, ballrooms, dining rooms, night club facilities and the like.

5. For tourist homes, cabins or motels—parking space for each guest or sleeping room or suite, plus one additional space for the owner or manager on the premises.

6. For trailer courts or camps—one parking space for each trailer space.

7. For lodging, rooming and boarding houses—one parking space for each four guest rooms, plus one additional space for the owner or manager if resident on the premises.

8. For private clubs or lodges (without sleeping rooms)—parking space equal in number to 10 percent of the capacity up to 500 persons and 20 percent of the capacity over 500 persons. Such capacity to be determined by the Commissioner of Buildings.

9. For fraternities, sororities and dormitories—one parking space for each one hundred and fifty square feet of sleeping quarters, plus one additional space for housemother or manager.

10. For hospitals—one parking space for each three hospital beds plus one parking space for each ten patient visitors per day to the

out-patient facilities, plus one parking space for each fifteen hundred square feet gross floor area in residents' quarters.

11. For sanitariums, convalescent homes, or homes for the aged —one parking space for each three patient beds.

12. For medical or dental clinics—one parking space for each office, consulting and operating room.

13. For mortuaries or funeral parlors—one parking space for each five persons capacity as determined by the Commissioner of Buildings.

14. For welfare institutions—one parking space for each four patient beds.

15. For bowling alleys—two parking spaces for each alley plus such additional spaces as may be determined by the Commissioner of Buildings for affiliated uses such as bars, restaurants and the like.

16. For convention halls, dance halls, skating rinks, assembly halls, exhibition halls, stadiums, sports arenas, auditoriums and gymnasiums (other than incidental to a school) or other places of assembly—parking spaces equal in number to 10 percent of the capacity up to 500 persons and 20 percent of the capacity over 500 persons.

17. For theaters.

a. (Indoor)—one parking space for each ten seats up to five hundred plus one parking space for each five seats above five hundred.

b. (Outdoor)—reservoir space equal to 20 percent of the capacity.

18. For church, high school, college and university auditoriums —one parking space for each twelve seats provided in said buildings or structures, the number of seats based on the capacity as determined by the Commissioner of Buildings.

19. For airports, railroad passenger stations, bus depots, or other passenger terminal facilities, (Special Uses), one parking space for each eight persons capacity, such capacity to be determined by the Commissioner of Buildings.

20. For banks, business or professional offices, or public adminis-

tration buildings—one parking space for each 400 square feet of floor area.

21. For establishments handling the sale and consumption on the premises of alcoholic beverages, food or refreshments—having more than 1,500 square feet of floor area under one roof devoted to such use or uses—one parking space for each 300 square feet of retail floor area over and above 1,500 square feet.

22. For retail stores (individual or in groups) under one roof, having a total floor area of 2,000 square feet or more devoted to retail sales—one parking space for each 300 square feet of retail floor area over and above 2,000 square feet.

23. For furniture and appliance stores, motor vehicle sales, wholesale stores, household equipment or furniture repair shops, or machinery sales, having more than 2,000 square feet of floor area under one roof (individual stores or groups of stores) in one structure—one parking space for each 600 square feet of floor area over and above 2,000 square feet.

24. For manufacturing and industrial uses—(held for further study).

While the zoning ordinance will provide relief for new construction after its passage, a large segment of the problem will remain to be solved by other means. The most significant of these is the new open-end parking facility bond issue. The first $50,000,000 of the issue can be issued solely on the basis of studies by engineers of known experience in estimating revenues from traffic and parking facilities. Additional bonds can be marketed after the first fifty millions when experience meets the additional test of earning power. The test of earning power will be the actual experience of at least twelve prior months of operation which, combined with estimates of future earnings, will meet ordinance requirements. As long as the city can meet these requirements, additional bonds can be issued.

The Chicago program is unique in that it provides for parking facilities anywhere within the city. Previous revenue bond program developed in other cities have been limited to certain small areas of the city. As needs developed in other sections, additional programs were developed for those sections, often with different operating and underwriting bases. The danger of such procedures is the possibility

that one of the separate issues might fail. Such failure automatically casts doubt on all future parking programs of the city and, for all practical purposes, precludes future revenue bond issues.

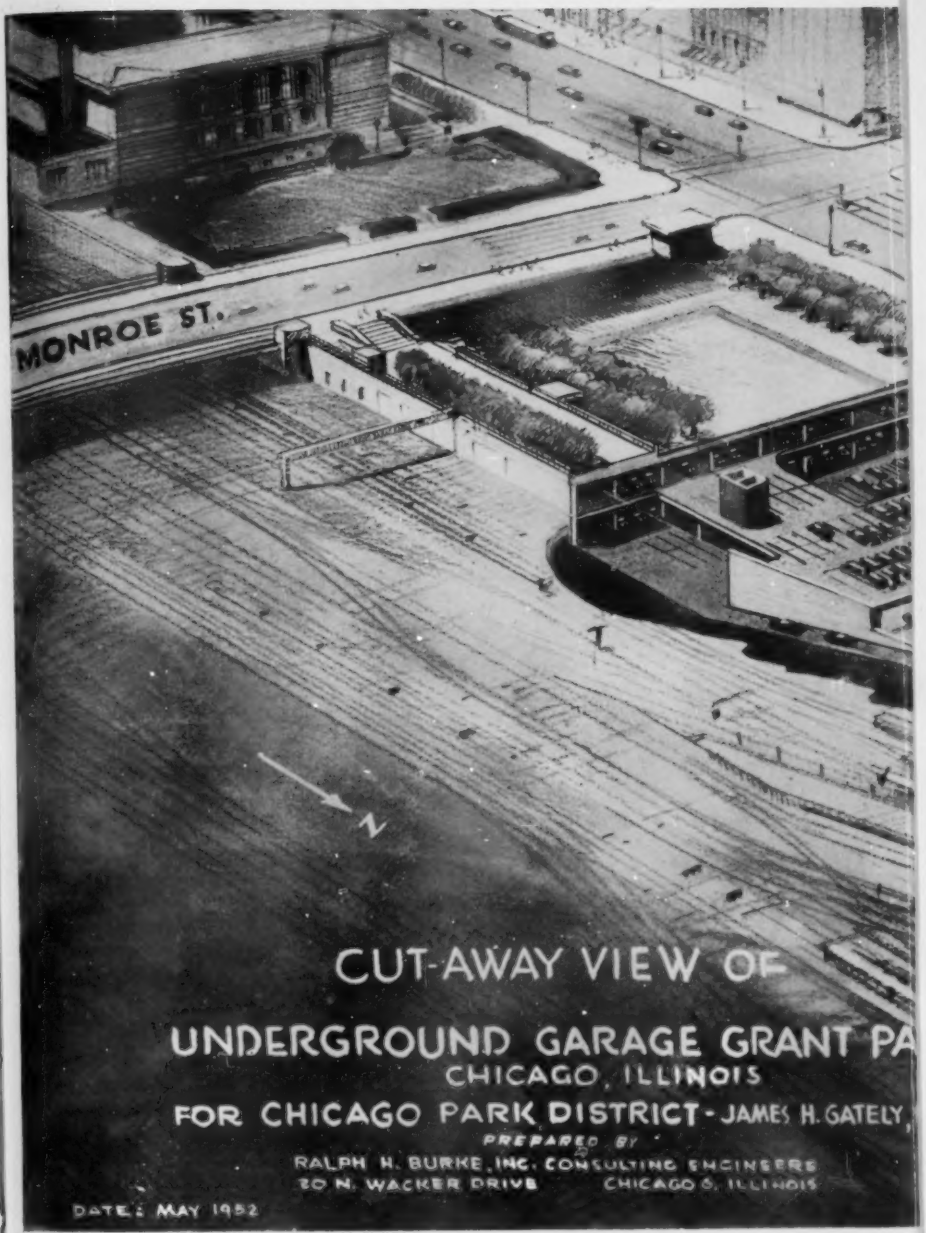
Chicago's program, being city-wide, will permit stronger areas to bolster the weak through the initial stages of development. In the early stages of the Chicago plan, three separate programs were proposed, having different operating and fianancial structures. These three, combined with the existing parking meters, formed the initial stage of the city-wide program.

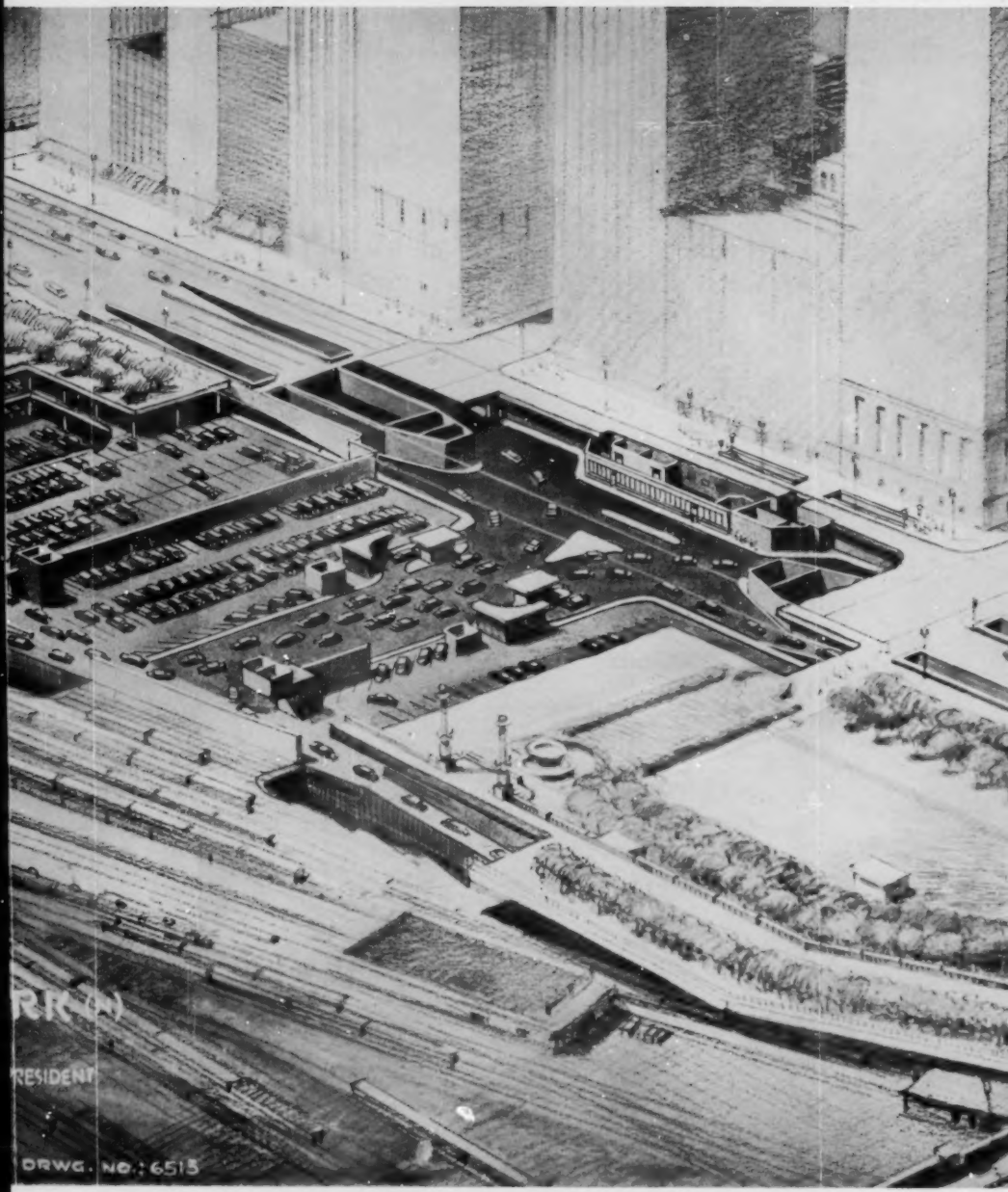
The initial program, authorized at the time of writing, consists of three multiple-deck parking lots and two elevator-type garages in the central business district; three multiple-deck lots and one elevator-type garage in the area just north of the central business district known as the North Michigan Avenue area; and seven parking lots in Chicago's largest outlying shopping district, known as the 63rd and Halsted Shopping Center.

Not included in the city's program, but to be constructed under public auspices are the two facilities in Grant Park just east of Michigan Avenue. They are to be constructed by the Chicago Park District as underground facilities with the park replaced. The northerly Chicago Park District facility, between Randolph and Monroe Streets, is presently under construction at an estimated cost of $6,750,000.

The following table shows the capital requirements for the initial city parking program referred to above:

Land and Construction	
Central Business District	$9,850,000
63rd and Halsted	$1,443,000
Parking Meters	1,200,000
North Michigan Avenue Area	6,621,000
Interest at 3½ per cent	
Two-Year Construction Period	1,582,000
First Year of Operation	791,000
Miscellaneous and Financing	1,113,000
Total	$22,600,000


MONROE ST.
N
CUT-AWAY VIEW OF
UNDERGROUND GARAGE GRANT PA
CHICAGO, ILLINOIS
FOR CHICAGO PARK DISTRICT - JAMES H. GATELY,
PREPARED BY
RALPH H. BURKE, INC. CONSULTING ENGINEERS
30 N. WACKER DRIVE CHICAGO 6, ILLINOIS
DATE: MAY 1952



Artist's view of 2,400 car-space underground garage on two levels under Michigan Avenue and Grant Par

l Grant Park on the Lake Front.

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Financing a program of the magnitude contemplated required many meetings between city officials, bond underwriters, legal counsel and engineers. The city officials promoted the necessary state enabling-legislation and passed the required ordinances. The bond underwriters and legal counsel advised the city concerning requirements of investors and legislation needed. Engineers made surveys to estimate potential use, capital and operating costs of the various facilities.

Section 52.1 of Chapter 24, Illinois Revised Statutes, 1951, permits the development, acquisition and operation of off-street parking facilities by cities and villages. It is perhaps the best statute under which any muncipality can operate. Several limitations are placed upon municipal operation, the most important being the requirement that the facilities be financed solely from revenues and that no proprietary uses (i.e. sales of gasoline, etc., rental of store space, etc.) be permitted. These restrictions require that the parking fees provide the entire cost of the facilities. It is obviously important that the statute under which a program the size contemplated in Chicago is to operate be legal. The validity of the act was tested before the Illinois Supreme Court in case of Poole vs. City of Kankakee (1950) 406 Ill.521. The act was found valid in all of its parts, thereby clearing the way for the Chicago program. The City Council, on September 18, 1952 adopted an ordinance authorizing the issuance of the City of Chicago Parking Facilities Revenue Bonds. The city agreed to place all revenues from the parking facilities, plus not less than 70 per cent of all parking meter revenues in trust for the retirement of the bonds. The city further agreed to establish and collect fees which would yield revenues sufficient to provide for:

(a) The estimated expenses of operation and maintenance of all parking facilities as provided in the budget for such period;

(b) An aggregate sum equal to at least one and one-half times the total amount of

1. The interest payments for such twelve months on all the bonds outstanding;
2. The aggregate minimum sinking fund payments provided for each series of bonds then oustanding to be made for such twelve months;

3. The principal amount of all serial bonds, if any, maturing by their terms during such twelve months;

(c) Such sums as may be required for Reserve Account payments on account of the bonds of any series.

While the legislation was being prepared and tested, the engineers were making surveys to determine the financial feasibility of the initial program. Information on parking needs, the habits of the motorists and other essential data were obtained by detailed surveys in each area. Estimates of site and construction costs were based on current experience in Chicago.

ESTIMATES OF COST FOR PARKING FACILITIES

	Capacity in Car Spaces	*Cost of Site Including Land and Improvements*	*Cost of Construction Including Contingencies*	*Total Cost*
Five Proposed Parking Facilities for the Central Business District	3,879	$3,102,000	$6,748,000	$9,850,000
Four New Lots and Four Existing Lots at the 63rd and Halsted Shopping Center	1,302	1,218,000[1]	225,000	1,443,000
27,000 Parking Meters	27,000	—	1,200,000[2]	1,200,000
Four Proposed Parking Facilities for the North Michigan Avenue Area	2,888	2,306,000	4,315,000	6,621,000
TOTAL	35,069	$6,626,000	$12,488,000	$19,114,000

[1] It is proposed to lease one parcel, presently used as a parking lot. The cost of leasing is included under Maintenance and Operation.

[2] Cost of meters includes the remainder to be paid on 22,000 meters in operation and the purchase of 5,000 new meters now authorized.

Estimates of revenues were made on the following basis:

1. The results of the various parking surveys form the basis for estimates of use and turnover in each of the proposed off-street facilities.

2. The schedule of fees for each parking deck or lot was established by prevailing rates in its vicinity.

3. Parking meter revenue was estimated on the basis of recent experience in Chicago.

Proposed Parking Deck west side of La Salle Street between Randolph and Washington Streets.

Aerial view of Chicago Central Business District Parking Site on western fringe of Chicago Loop area, to be improved with five-level garage, capacity 1,294 cars.

4. Estimated revenues include only fees for the parking of cars and do not anticipate any income from concessions or auxiliary services.

5. It is estimated that the proposed parking decks will reach normal operating capacity in 1958, and that they will remain at this level during the remainder of the life of the bond issue. Further increases in demand should be met by furnishing additional facilities.

6. Parking meters contemplated in the program will be installed by early 1953, and revenues per meter thereafter will be approximately the average rate prevailing in 1952.

Estimated revenues of the various facilities for the year 1958 are summarized as follows:

ESTIMATED GROSS REVENUES, MAINTENANCE AND OPERATING EXPENSES AND NET REVENUES—1958 LEVEL

	Estimated Annual Gross Revenues	*Estimated Annual Cost of Maintenance and Operation*	*Net Revenues*
Five Proposed Parking Facilities for the Central Business District	$1,526,000	$ 518,000	$1,008,000
Four Proposed Parking Facilities for the North Michigan Avenue Area	953,000	387,000	566,000
Four New Lots and Four Existing Lots in the 63rd and Halsted Shopping Center	177,000	58,000	119,000
Parking Meter Program (27,000 meters)	1,420,000[1]	650,000	802,000
TOTAL	4,076,000	1,613,000	2,495,000

[1] The total amount available to the parking program from parking meter revenues equals 70 percent of the gross—0.70 x $2,075,000.

Maintenance and operating costs were based on study of the operation of numerous similar facilities in other cities. In addition the operating methods proposed and estimates of operating costs were reviewed by a special consultant on the operation of parking facilities.

The following table summarizes the estimated annual revenues and expenses for the first six years of operation beginning in 1953.

The initial program of $22,600,000 is only the first stage of a program that ultimately may exceed $100,000,000. Three business

districts that might warrant municipal offstreet facilities have been included in the program. In addition, revenue bond facilities may be erected in existing critical residential areas where curb lanes will be required for the movement of traffic.

YEAR	GROSS ANNUAL REVENUES					TOTAL MAINTENANCE AND OPERATING EXPENSES	NET REVENUES
	CBD* REVENUE	NMA* REVENUE	5TH* REVENUE	METER REVENUE	TOTAL REVENUE		
1953	CONSTRUCTION PERIOD		$ 61,000	$1,420,000	$1,481,000	$ 673,000	$ 808,000
1954			159,000	1,420,000	1,579,000	708,000	871,000
1955	$1,297,000	$810,000	164,000	1,420,000	3,691,000	1,541,000	2,150,000
1956	1,373,000	858,000	168,000	1,420,000	3,819,000	1,567,000	2,252,000
1957	1,450,000	905,000	173,000	1,420,000	3,948,000	1,595,000	2,353,000
1958	1,526,000	953,000	177,000	1,420,000	4,076,000	1,613,000	2,463,000
1959	1,526,000	953,000	182,000	1,420,000	4,081,000	1,613,000	2,468,000
1960	1,526,000	953,000	186,000	1,420,000	4,085,000	1,613,000	2,472,000

*——CBD —— Central Business District.
NMA —— North Michigan Avenue Area.
STH —— Sixty-third and Halsted Shopping Center.

It is hoped that the offstreet program, coupled with an adequate zoning ordinance, will make Chicago a safer and more convenient place to drive.

Fringe Parking

D. C. HYDE

Mr. Hyde has been General Manager of the Cleveland Transit System since February 1947. For thirty-four years, he has been active in public transit. For fifteen years he was associated with the transit system in Milwaukee, where he started out in personnel and training work and then for ten years was Superintendent of the Schedule Department. After one year in Chicago with the Labor Bureau of the middle west, specializing in schedule work, he became associated in 1944 with the Cleveland Transit System as Director of Personnel. As General Manager, Mr. Hyde has played an active part in the Cleveland Transit System's $20,000,000 modernization program and in accelerating the large-scale development of express and special type bus services to every part of the community.

AUTOMOBILE registration in Cuyahoga County, Ohio, has increased sixty percent since 1945. Similar statistics could be quoted for nearly every metropolitan area in the country. This increase in automobile ownership has been accompanied by street widenings and the building of freeways to accommodate the increased number of vehicles on the streets. As a result, more people drive from their homes to the central business area. This has created a parking problem in many of the cities which is of great concern to public officials.

Parking at curbs in central business areas is being eliminated to permit movement of the increased number of automobiles. Under consideration in most large cities, and in many medium sized ones, are multi-storey garages, underground garages and development of fringe parking. Some of these plans are beyond the blueprint stage and development of such projects has already been partially accomplished.

Traffic congestion is the number one problem in cities; parking is a corollary problem produced by increased use of automobiles and traffic congestion. Any proposed solution of the parking problem, this writer believes, should at all times consider the number

one problem, traffic congestion. Any parking development that brings more automobiles on to business streets which are already clogged with traffic is more apt to harm than to help that area.

When downtown streets were laid out, populations of cities were small and most persons either walked to the stores and offices or rode public transportation. Those same streets must be used today by much greater numbers of persons going to and from work, shopping, or business. The daytime population of today's central business areas will not permit all or anywhere near all persons to get there by automobile—that is, to get within a short walking distance of their destination.

Yet some planners and public officials seem to be trying to do just that. Other planners have recognized the futility and disastrous results of trying to get more and more automobiles into areas already too congested. The latter have concluded that this can be done only by street widenings that would cost many millions of dollars. They have seen examples of its having caused business to move out of the central business area, with the resultant lowering in total value of tax producing real estate.

Leaders Recall

Some public officials and business leaders are recalling that central business areas developed with increased use of public transportation. As they look down the street at two lanes of automobiles backed up for a solid block, they remember when a single street car could swiftly move as many persons as occupy the block full of automobiles. They know that downtown streets could not possibly handle in automobiles the persons still riding public transit. They shudder at the effort of other community leaders to provide still more parking right next to or very near the largest office buildings or stores.

They know that already some persons do not like to come downtown because of traffic congestion and slowness in getting around, and that huge thousand-car garages will only add more congestion and make it less attractive for those who must use an automobile or who use public transit. They believe that it is important to get all-day parkers out of the central business area so that present parking

spaces will be made available to shoppers and business people who need parking for only a short time.

The concern over this matter of stifling traffic congestion by some of the best informed persons, has prompted such recent statements as the following:

Joseph Berger, Chicago, President of the Central Parking Council: "Mass transportation is the salvation of our cities. It should be taken out of politics and placed on a sound business basis. If this is done it will attract private capital and capable management. The cities should do their part by clearing the main arteries of parked vehicles so that mass transportation can be made rapid and safe. If this is done, downtown merchants and property owners need have no fear of their ability to compete with outlying shopping and business centers. They have so many advantages that only their blindness and unwillingness to face reality can swing the scales against them."

Among Mr. Berger's suggestions for downtown merchants was this: "Fight mass parking in the downtown area. Mass parking caters to the worker and not to shoppers. It will create traffic snarls during the morning and evening rush hours such as we have never before witnessed. It will ruin the mass transportation system and it will drive shoppers away from downtown."

Richard Seltzer, Philadelphia, Past President of the Urban Land Institute, stated: "It may be possible to close certain shopping streets to vehicular traffic, as has been proposed in Rye, New York. In Buenos Aires, Argentina they have actually created a mall for one of their principal shopping streets by prohibiting vehicular traffic from 10 A.M. until 6 P.M. The pedestrians use the entire street from building line to building line."

Professor William L. C. Wheaton, Department of Regional Planning, Harvard University, points out that: "Every superhighway you build into the center of cities will cost you about 60 acres of land. Twenty acres for right-of-way, then 40 acres to park about a third or a quarter of the cars that highway will bring into the city. It seems to me that unless something very, very radical is done to improve mass transit, there will be a gradual trend toward the demolition of buildings to make room for the automobiles."

William G. Austin, Executive Director of the Retail Merchants' Association of Kansas City, Missouri, points out the need for intelligent planning on downtown travel in the following statement: "Records show that nearly one-third of all the taxes on real estate are collected from the owners of downtown properties. It is unthinkable that we should allow the skyscrapers of our modern cities to become "bat roosts." If big business moves all over the outlying sections, then that one-third cost of all real estate taxes now levied upon downtown properties and which goes to provide schools, hospitals, fire prevention, police protection and other city services, must necessarily be imposed on holders of real estate in the outlying sections. I think we are a long way from "ghost towns," but the primary problem of traffic congestion certainly gives us reason to plan more intelligently on the subject of downtown travel."

Harland Bartholomew, St. Louis, noted City Planner, feels that: "It would be foolhardy for a municipality to invite or encourage a shift in the location of its central business district. This may happen, however, if excessive street congestion or abnormal imbalance of traffic flow is permitted. . . . It should be evident to all who are genuinely interested in the present as well as the future welfare of our cities that the streets of our central business districts should be cleared for expeditious mass transportation flow, regardless of whose individual interests are involved or whose toes may be stepped upon. This is a matter of paramount interest—a matter of dominant public necessity. Unless we can accept this as axiomatic—as a point of departure in dealing with traffic congestion problems, it is apparent that our cities will experience growing instability, decentralization and abnormal economic losses, far beyond what has been experienced in the past."

The Urban Land Institute, an independent non-profit agency which studies trends affecting real property and fosters research and education in planning development in cities, has developed the following policy on parking: "Resolved that a solution of the automobile parking problem is essential to the preservation of an adequate central business section. The preservation of an adequate central business section is vital as a tax base for required municipal services and a necessary convenience to the public. Therefore, the Urban

Privately owned parking lot at E. 22nd and Euclid, capacity 1,080 cars; with three adjacent lots serves 1,400 cars. Parking fee 7:00 A.M. to 10:00 P.M.—35 cents.

On Cleveland's West Memorial Freeway. Modern forty-four-passenger bus can carry the equivalent of thirty-seven automobiles. Municipal free parking lot serves this freeway.

Land Institute believes that the solution of this problem is properly a civic responsibility and the problem of the entire community, and that study is needed to develop reliable formulae for determining the optimum parking needs of a community."

The previous discussion, with the quotes of outstanding public officials and business leaders, points to the necessity of more fringe parking. It is not effective to tell American people, "Use public transportation; it will more efficiently use street space and save cities millions of dollars." In spite of the headaches of driving an automobile in rush hours, many persons are going to keep right on driving them. Public officials should have something to say about where automobiles are parked. Traffic, parking and speed regulations exist on most streets for the safety of the community and its people.

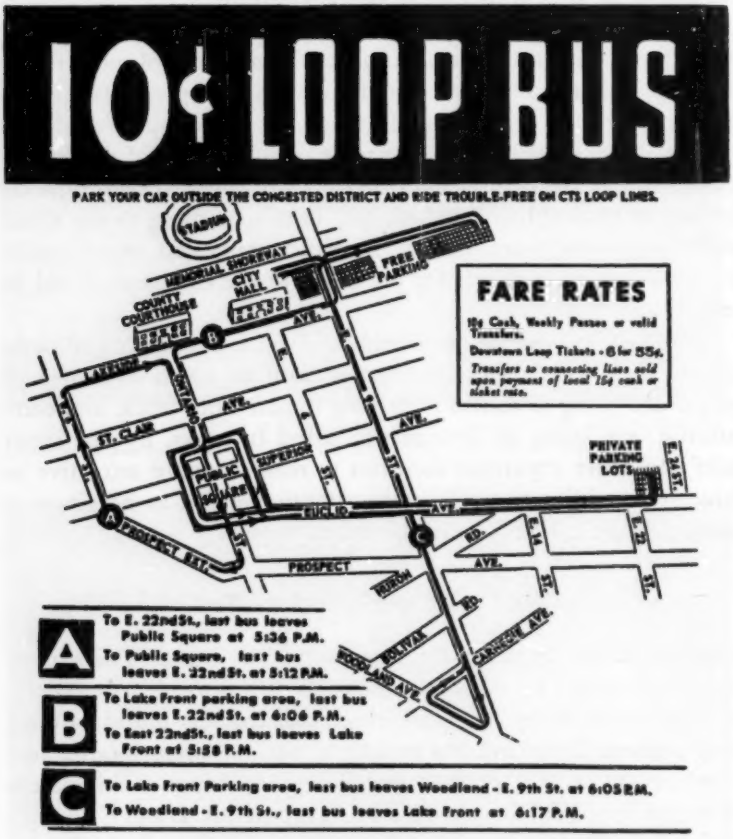
Similarly, consideration should be given to the traffic and parking problem in the central business areas if we are to save them. If people are going to continue driving to and from work, and communities are going to continue building freeways, by-pass inner belts and other expensive facilities to make it more attractive to drive automobiles to work, more attention needs to be given to parking at the fringe of central business areas.

Cleveland Experience Says 'Yes'

Will people use fringe parking lots, served by buses? The experience in Cleveland for the last seven years points to a "Yes" answer. In addition to the usual small fringe parking lots found in most communities, Cleveland has two large parking areas located just outside of the central business area. These two fringe parking areas are served by special downtown loop bus routes, A, B and C, operating between the lots and the main business center, as shown by the map. A special low rate fare of 10 cents cash or six tickets for 55 cents is charged on these downtown loop route buses.

One of the fringe lots is on property owned by the City of Cleveland and parking is free. (Photo A) This lot is located just north of the business area near the shores of Lake Erie. A freeway from both east and west passes this parking area, so that automobile

drivers from either direction may get to this lot without passing through the streets of the business area. This is an important factor in giving relief to traffic congestion in the downtown area. This


10¢ LOOP BUS
PARK YOUR CAR OUTSIDE THE CONGESTED DISTRICT AND RIDE TROUBLE-FREE ON CTS LOOP LINES.
STADIUM
MEMORIAL SHOREWAY
CITY HALL
FREE PARKING
COUNTY COURTHOUSE
PUBLIC SQUARE
ST. CLAIR AVE.
SUPERIOR
PUBLIC AUDITORIUM
EUCLID AVE.
PRIVATE PARKING LOTS
PROSPECT AVE.
PROSPECT
WOODLAND AVE.
CARNEGIE AVE.
FARE RATES
10¢ Cash, Weekly Passes or valid Transfers.
Downtown Loop Tickets - 6 for 55¢.
Transfers to connecting lines sold upon payment of local 10¢ cash or ticket rate.
A
To E. 22nd St., last bus leaves Public Square at 5:36 P.M.
To Public Square, last bus leaves E. 22nd St. at 5:12 P.M.
B
To Lake Front parking area, last bus leaves E. 22nd St. at 6:06 P.M.
To East 22nd St., last bus leaves Lake Front at 5:38 P.M.
C
To Lake Front Parking area, last bus leaves Woodland - E. 9th St. at 6:05 P.M.
To Woodland - E. 9th St., last bus leaves Lake Front at 6:17 P.M.
FOR THE CONVENIENCE OF THOSE DETAINED BEYOND THIS HOUR, LAKE SHORE EXPRESS BUSES (Route 39) FARE 20¢ WILL STOP AT THE LAKE FRONT PARKING AREA AFTER 6:00 P.M.
BOARD AT: Superior—E. 3rd, Rockwell—E. 6th, Rockwell—E. 9th, E. 9th—St. Clair, E. 9th—Lakeside.

free parking lot is 0.75 of a mile from Euclid Avenue, Cleveland's main street.

The municipal lake front lot started out with a parking area large enough for about 500 cars. Its popularity required that it be

expanded to an area which now can accommodate 2,500 automobiles. Two downtown loop bus routes, B and C, serve this area. Route C operates directly south across East 9th Street to smaller lots south of the business center. Route B operates through the Public Square and up Euclid Avenue to a large private parking lot on the eastern fringe of the central business area.

The East 9th Street line, or Route C, provides buses every five minutes during the peak rush hours and every nine minutes in the non-rush hours. Buses on Route B provide service approximately every three minutes, in the rush hours and every six minutes in off-peak hours. Both bus lines operate from about 7 A.M. to 6.15 P.M. This parking lot is used almost entirely by all day parkers.

The second large fringe parking lot is located at East 22nd Street and Euclid Avenue, just at the eastern fringe of the downtown business area approximately one mile east of Cleveland's famous Public Square. It accommodates 1,080 cars at one time and with turnover up to 1,400 during the day. The charge for all day parking at this lot until recently was 25 cents. A 35 cent fee has been in effect since April 1, for parking from 7 A.M. to 10 P.M.

The downtown loop bus Route B, serving the municipal lake front lots terminates at this privately owned lot. Another bus line, Route A of the special downtown loop bus service, also starts from this location and operates on Euclid Avenue through Public Square and to the western portion of the downtown business district. The service on the two downtown loop bus lines, A and B, is so scheduled as to give a two minute frequency on Euclid Avenue.

The owner of this second large fringe parking area has provided a roadway right into his lot specifically reserved for buses and has installed several shelters. Such accommodations makes bus service very convenient for its customers. The popularity of this successfully operated fringe lot is so great that it is often filled by 9 A.M.

Results

The success of fringe parking lots in Cleveland can best be measured by their results. Among them are:

1. These lots are popular and used to capacity. It has been neces-

sary to extend bus service until after 9 P.M. on Monday nights when downtown stores are open. These fringe parking lots are responsible for a substantial number of persons coming downtown to shop who would go elsewhere if they had to fight the traffic congestion in the central area.

2. Lower cost to parkers. Fringe lots use land having a much lower value than lots or garages in the central area and therefore permit lower parking rates.

3. Parking space is made available within the central business area for shoppers and business men requiring parking for a short interval of time. In some cities the all day parkers take up most of the available parking space, thereby adding to the inconvenience for the shopper or business man.

4. Traffic congestion on central business district streets is eased. Traffic in Cleveland, as in all large cities, is bad, but the congestion is nowhere nearly as bad as in many other cities. As in most cities, the peak of traffic congestion occurs in the half hour period from 5 to 5:30. A recent check in this half hour period showed 400 persons riding the buses to the lake front parking lot. Nearly as many ride to the Euclid Avenue fringe lot in the same period. Between 7 A.M. and 6:15 P.M. more than 4,000 persons ride from and to these two lots. If these 4,000 persons using the two fringe lots had parked in the heart of the central business area the added number of automobiles would make traffic on streets in that area intolerable. A recent report on parking prepared by the Cleveland City Planning Commission shows that the peak requirement for the downtown area was 24,215 car spaces. The two fringe parking areas served by downtown loop bus Routes A, B and C provide space for 3,900 cars.

5. Time is saved. The traffic relief given by fringe parking permits buses serving these lots as well as all other buses and automobiles to move faster through the downtown area. Time is therefore saved for all of the thousands of persons driving through or leaving the central business area.

Fringe parking may not be a panacea for today's traffic problems, but it will certainly do a lot to help solve them. Business interests in downtown areas are beginning to realize that the increase in traffic congestion since the rather recent days of gas rationing during

World War II, *has not been brought about by more people coming downtown.* It is merely the *result of more persons driving automobiles.* It is the result of too many persons trying to push automobiles through streets that were never laid out for such numbers of vehicles.

They are beginning to learn that multi-storey garages in the center of a business area only result in pouring more cars onto already congested streets and slowing down traffic still further. They want the shopper and business man to be able to get in and out of the central area more freely. They are therefore beginning to promote more fringe parking, especially for all day parking.

One of the most recent cities to recognize the merit of fringe parking is Milwaukee. There, three banks and two department stores have joined to provide space for all-day parkers who work in the congested central business area, thus freeing parking facilities for shoppers. The corporation is negotiating with the local harbor commission for the lease of ten acres of ground along the lake front. It is planned to locate a parking lot there with 1,500 spaces. A parking rate of 35 cents a day is contemplated with that charge to include a bus ride into and out of the business area. When realistic and practical minded business men promote such parking to improve facilities for moving people and goods in the downtown area and thus preserve their own investments in the area, public officials ought to sit up and take notice.

Against Pouring Cars on Congested Streets

One final word in case anyone thinks the writer's interest is selfish because he is engaged in the public transportation business. The transportation system in Cleveland is owned by the city of Cleveland, so there is no profit motive in encouraging greater use of fringe parking with feeder bus lines. There is a real interest in putting a stop to any efforts to pour more automobiles on to streets already congested.

Some city planners, traffic officials, and others have said that the only economical relief for traffic congestion is greater use of public transportation and have exhorted the operators of public transit to improve their service to make it more attractive and thereby in-

crease its use. Mass transportation has suffered along with all others, as its service has been slowed down with increased congestion. Mass transportation vehicles still carry more than half the persons entering and leaving central business areas in major cities.

Operators of those vehicles desperately want to improve their service. Relieving traffic congestion in central business areas will help them accomplish this. Fringe parking will help relieve traffic congestion and benefit all; the riders of public transit, the automobile driver, the merchant, the business man, and the property owner.

The Buffalo Truck Route System

HENRY W. OSBORNE

Mr. Osborne has been traffic engineer and advisor in Flint, Michigan, Milwaukee, and Buffalo. Besides his municipal connections, he is consultant to six cities in the Niagara Frontier area and twenty private and business organizations. He is a member of the Institute of Traffic Engineers, American Institute of Electrical Engineers, Illuminating Engineering Society, Past President of the Engineering Society of Buffalo and a member of the National, State and Erie County Chapter of the Society of Professional Engineers. He is also a licensed professional engineer in the Province of Ontario, Canada.

UNTIL recently, truck traffic used Buffalo's 645.8 miles of paved streets with no local limit on the weight of trucks permitted to use city streets, and truck traffic was free to go anywhere in the city.

Buffalo is the second largest city in New York state with a population close to 600,000 within the city limits and more than 1,200,000 in the metropolitan area. It is the hub of activity in the Niagara Frontier. About midway between New York and Chicago, it is centered between large cities in northeastern United States and Canada.

Buffalo is the western terminus of the cross-state 427-mile Thruway from New York City, now under construction and scheduled to be completed in 1954, and also the western terminus of the New York State Barge Canal. The city's location at the western end of New York State and the eastern end of Lake Erie makes it an important junction for both intrastate and interstate truck transportation. The international Peace Bridge in Buffalo provides an important link for trucking operations between the United States and Canada.

The trucking industry plays a vital role in supplying the city's essential needs and in keeping the Niagara Frontier's innumerable and diversified plants, businesses and factories functioning continuously and smoothly. Of western New York's approximately 280 Interstate Commerce Commission carriers, more than 100 over-the-road carriers have their offices in Buffalo.

It was inevitable that ever-increasing truck traffic and crumbling street pavements in Buffalo would attract the attention of city officials. This developed several years ago when the only prohibition on truck traffic was a long-standing ban forbidding trucks on parkways within the city. The city council had mounting evidence that something definite would have to be done to restrict heavy truck traffic. The only immediate solution at that time was to rename streets as parkways to keep them free of trucks; this was done in several instances before the inescapable proposal came to create a truck route system.

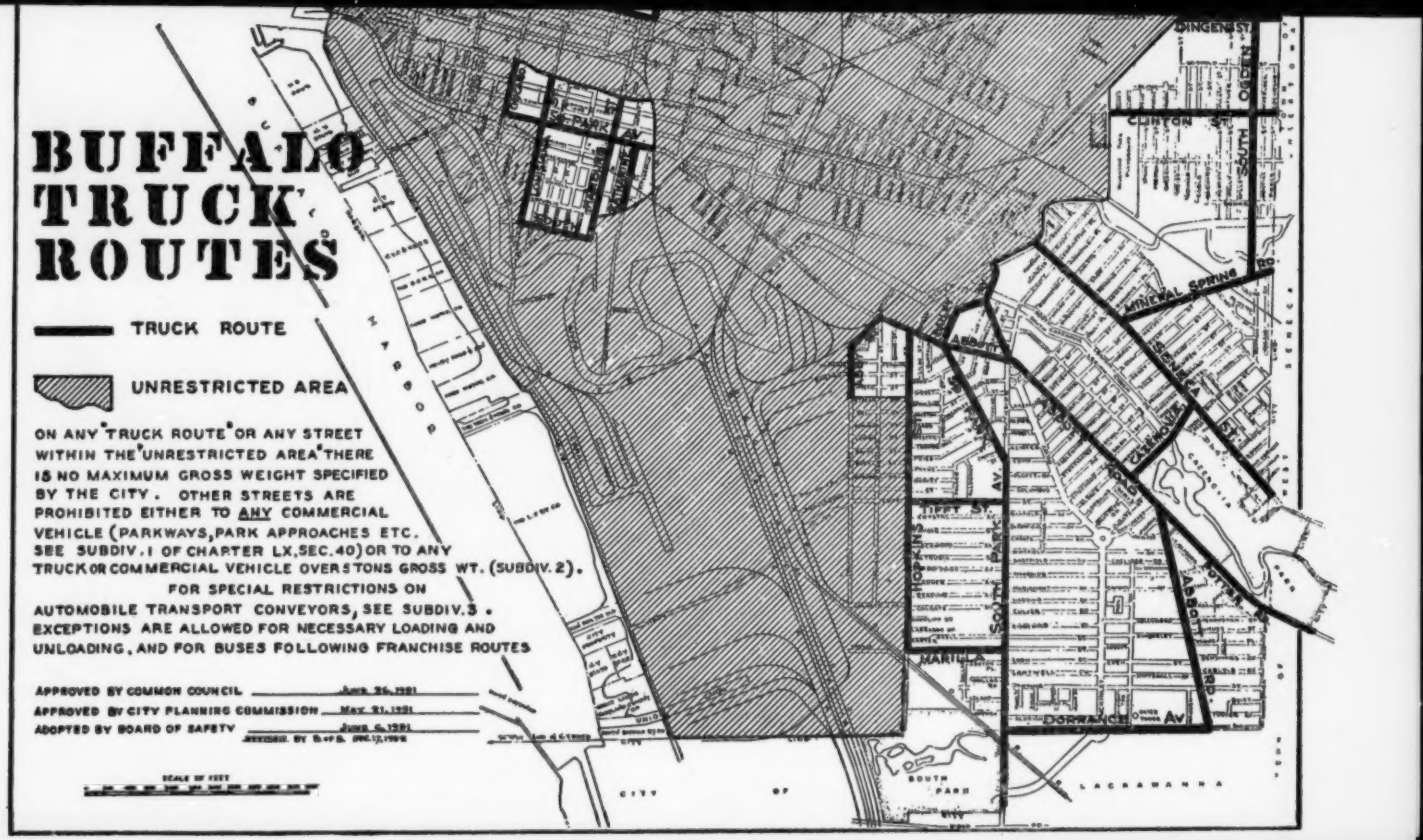
City legislators voiced complaints that heavy truck traffic was ruining pavements in residential streets. The property owners on one street in particular—a thoroughfare used extensively by truck traffic entering and leaving Canada by way of the Peace Bridge in Buffalo—opposed repaving the street until they were assured they wouldn't see a repetition of the experience.

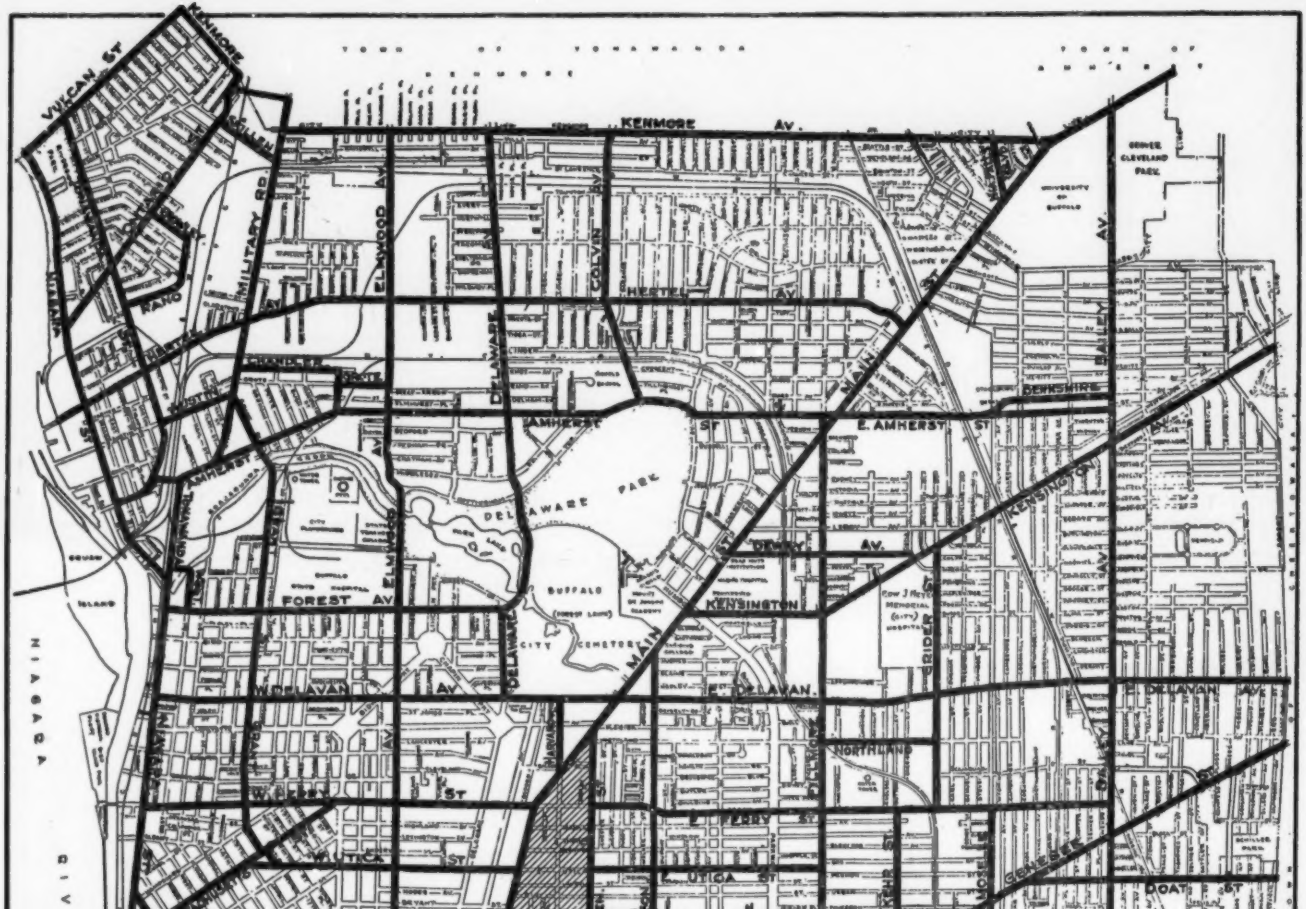
The effect of heavy trucks upon traffic and pavements was cited in a report of an engineering study by the Buffalo Port Commission which found that many over-the-road carriers made deliveries in the congested city area with huge semitrailer trucks.

"These trucks," the report noted, "add seriously to the traffic problem and because of their great weights subject the street pavements to considerable abuse for which they were originally not designed, so that extensive repairs and replacement are necessary."

Truck Route System Mapped Out

That was after the Buffalo Division of Safety came forward in late 1948 with its outline of a truck route system mapped out for study by the Board of Safety, which heads up the Division. The tentative plan was submitted to the Safety Board which invited suggestions for improving it from the City Council, the Department of Public Works, the City Planning Commission, truckers' associations and truck drivers' organizations. Two types of trucking—house-to-house delivery and over-the-road operations—were involved in the proposed plan and for that reason both local and long-haul operators and drivers were requested to cooperate in the study.


BUFFALO
TRUCK
ROUTES
TRUCK ROUTE
UNRESTRICTED AREA
ON ANY TRUCK ROUTE OR ANY STREET WITHIN THE UNRESTRICTED AREA THERE IS NO MAXIMUM GROSS WEIGHT SPECIFIED BY THE CITY. OTHER STREETS ARE PROHIBITED EITHER TO ANY COMMERCIAL VEHICLE (PARKWAYS, PARK APPROACHES ETC. SEE SUBDIV. I OF CHARTER LX, SEC. 40) OR TO ANY TRUCK OR COMMERCIAL VEHICLE OVER 5 TONS GROSS WT. (SUBDIV. 2).
FOR SPECIAL RESTRICTIONS ON AUTOMOBILE TRANSPORT CONVEYORS, SEE SUBDIV. 3.
EXCEPTIONS ARE ALLOWED FOR NECESSARY LOADING AND UNLOADING, AND FOR BUSES FOLLOWING FRANCHISE ROUTES
APPROVED BY COMMON COUNCIL June 26, 1951
APPROVED BY CITY PLANNING COMMISSION May 21, 1951
ADOPTED BY BOARD OF SAFETY June 6, 1951
SCALE IN FEET
Lagoon
DINGENS ST.
CLINTON ST.
SOUTH PARK AV.
MINERAL SPRING RD.
SENECA ST.
SOUTH PARK AV.
MARILLA ST.
DORRANCE AV.
SOUTH PARK
LACKAWANNA
CITY OF


KENMORE AV.
VULCAN ST.
KENMORE
MILITARY RD.
ELMWOOD AV.
DELAWARE AV.
COLVIN BLVD.
HERTEL AV.
MAIN ST.
BAILEY AV.
DENSHIRE
E. AMHERST ST.
AMHERST ST.
DELAWARE PARK
KENSINGTON AV.
FOREST AV.
BUFFALO CITY CEMETERY
MAIN ST.
W. DELAVAN AV.
E. DELAVAN AV.
NORTHLAND
W. FERRY ST.
E. FERRY ST.
W. UTICA ST.
E. UTICA ST.
MOSELEY
GENESEE
BOAT ST.
NIAGARA

WILLIAM ST
BROADWAY
MAIN ST
RIVER

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A series of
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Truckers
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in June, 1951

ıggestions and opinions also were solicited from the police de-
ıent, the Peace Bridge Authority and other groups and indi-
ıls; copies of a city map showing the proposed network of truck
s were printed and distributed.

series of meetings with interested groups followed and in
ember, 1949 the Board of Safety, which has the exclusive power
act traffic regulations in Buffalo, approved a local ordinance
ing all types of trucks and commercial vehicles from 112 streets.
ll streets not so designated, truck traffic was free to move. These
the streets picked as "natural routes" for trucks to enter and
the city.

The ordinance classified streets in several categories. In the first
were parks and parkways and certain streets and avenues—prin-
ly residential streets—from which all truck traffic was excluded.
xceptions in these two classifications, of course, were allowed.
cles making regular route deliveries along the street, like milk
bakery trucks, and vehicles bound for particular destinations
ake one-stop deliveries of such commodities as fuel, furniture,
ding materials and the like, were permitted to use these streets.
ıs written out, however, that such vehicles must approach their
nation and get off the restricted streets after making their de-
ies by way of the nearest principal intersection.

Listed in the third category were streets where auto carriers
e banned unless making delivery on that street, in which event
had to go to their destination and return by the shortest route.
ordinance, while rigid in its prohibitions on truck traffic, was
e flexible enough to allow further changes as the need arose,
er to ban trucks on additional streets not already specified by
e in the ordinance or to remove streets from the prohibited list.
Truckers gave almost one hundred percent cooperation on the
ı, indicated their willingness to abide by it and assisted in the
cational campaign to familiarize all drivers and transportation
panies with the routes. While enforcement was held in abeyance,
City Planning Commission in May, 1951 gave the finished plan
tamp of approval. The official map of truck routes was adopted
he Board of Safety and the City Council added its endorsement
une, 1951.

One Obstacle Delayed Enforcement

The plan was put into effect, but only on a voluntary basis. There was still one obstacle delaying enforcement of the truck route system. That was Section 90, Subdivision 1 of the State Motor Vehicle and Traffic Law, which says:

"Powers of local authorities:

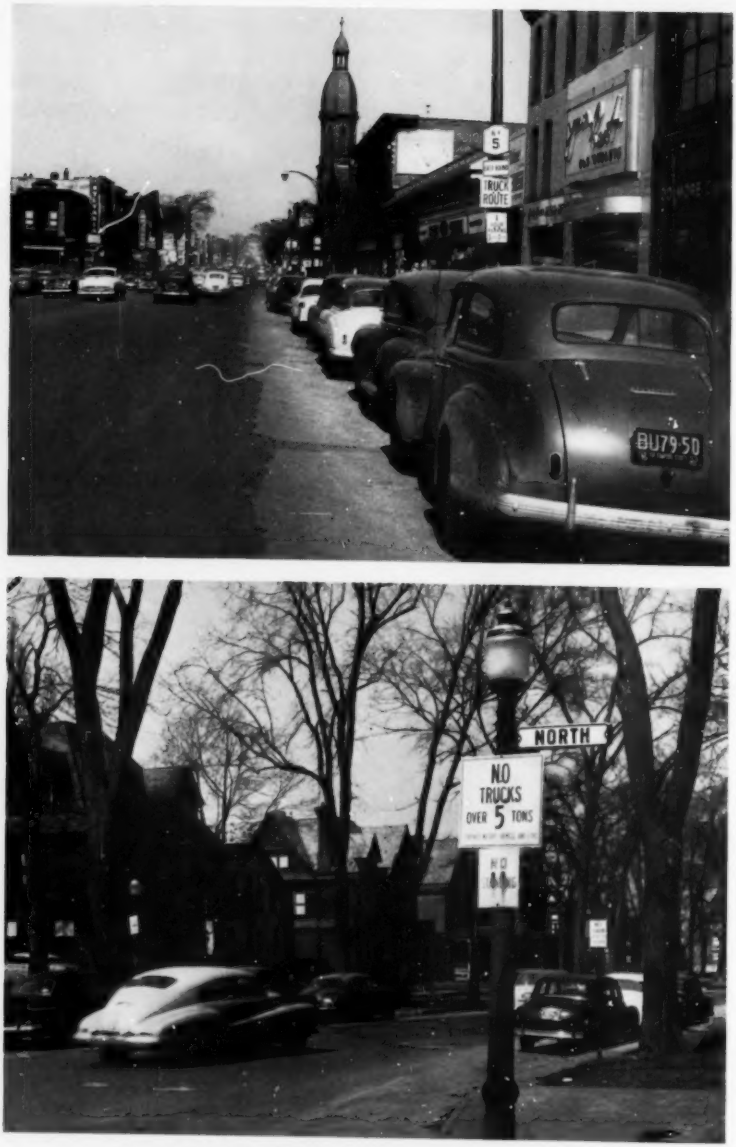
"1—The legislative body of a city, village, town of the first class or town of the second class having a population in excess of twenty-five thousand, or any municipal officer, board or body designated by it, is hereby authorized to designate highways, respectively, in such city or village, or such town outside of any village therein, in which vehicles shall proceed in one direction only, or from which heavy trucks shall be excluded. Such designation shall not be construed to prevent deliveries of merchandise or other property along such highways. Highways so designated shall be marked at all intersections by conspicuous signs which shall be visible during the hours in which such designation is to be observed. No state highway shall thus be designated without the approval of the state traffic commission."

It is obvious that this provision as it applied to truck routes embodied the negative approach, making it incumbent upon cities to post signs at every intersection of every street from which truck traffic was excluded. For Buffalo, that meant thousands of such signs.

The wording of the state law made it necessary in enacting the local truck route ordinance to designate the specific streets declared off-limits to trucks of more than five tons. The off-limit streets were so selected as to compel trucks to use certain preconceived routes.

In the interest of economy, the Board of Safety planned to begin by posting only a limited number of streets where truck abuses were the greatest, and continue the ban on all trucks, regardless of weight, from parkways, park drives and park approaches. All streets in downtown Buffalo and in the industrialized areas of South Buffalo were unrestricted.

Meanwhile, Buffalo safety and planning officials tried unsuccessfully to have the state legislature change the state law so it would be possible for cities to ban all trucks regardless of weight (except for necessary deliveries of food, milk and the like) from residential streets. The Buffalo authorities also sought to give a positive ap-



Signs Designate Permitted and Restricted Truck Routes.

proach to the state law, making it necessary to post only the lesser number of streets where trucks are permitted to operate.

The first attempt, in 1951, was unsuccessful. But in 1952, after the proposed changes were given support by other communities and organizations in the state, the legislature amended the law by adding the following subdivision:

"1-a—Nothwithstanding the provisions of the foregoing subdivision, the legislative body of a city, village, town of the first class or town of the second class having a population in excess of twenty-five thousand, or any officer, board or body designated by it, may by ordinance or regulation establish a system of truck routes and provide that all trucks having a total combined gross weight of vehicle plus load in excess of five tons shall be excluded from all streets in such city, village or such town outside of any villages therein, except from those streets which form a part of the system of truck routes upon which trucks are permitted to travel and operate. Such exclusion shall not be construed to prevent deliveries of merchandise or other property along the streets from which such trucks are excluded. Any system of truck routes established pursuant to the authority contained herein shall provide suitable connection with all state routes entering and leaving such city, village or town. No state highway maintained by the state shall be designated as a part of such system of truck routes, nor shall any such trucks be excluded from any state highway maintained by the state, without approval of the state traffic commission. All streets forming part of such truck route system shall be marked by conspicuous signs bearing the word "truck route" in letters not less than five inches in height, such signs to be spaced not more that fifteen hundred feet apart. In addition, conspicuous signs bearing lettering not less than five inches in height, such signs to be adequately illuminated between sunset and sunrise or to be constructed of a reflecting material so as to be easily readable at night when lights from vehicle headlights fall upon such signs, shall be placed on each main highway entering such city, village or town, at or near the point where such highway crosses or meets the boundary line of such city, village or town, indicating that trucks having a gross weight in excess of five tons, including load, are excluded from all streets within said city, village or town, except those streets designated as part of the authorized truck route system."

Where the original provision was rather obscure and gave communities authority only to exclude "heavy trucks," the new provision clearly established the right to create truck routes and to ban trucks exceeding five tons in weight, with load. Further, it spelled out exactly the positive approach which Buffalo safety officials had

fought for and made it unnecessary to post every intersection. One result of the change was that it saved the city thousands of dollars in the cost of such signs. The estimated saving was $40,000. Most of all, it provided a simple method of establishing truck routes.

Governor Thomas E. Dewey signed the new provision and it became effective July 1, 1952. Shortly afterward, the Board of Safety enacted a substitute city ordinance conforming with the law by designating the streets on which trucks are permitted to operate. In effect, it was the same truck route system established by the original ordinance, but it now was a system that could be made official and put into daily practice.

Minor revisions have been made since it was put into effect and enforced. These revisions concerned a few streets that were removed from the truck route system because of the residential character of the neighborhoods.

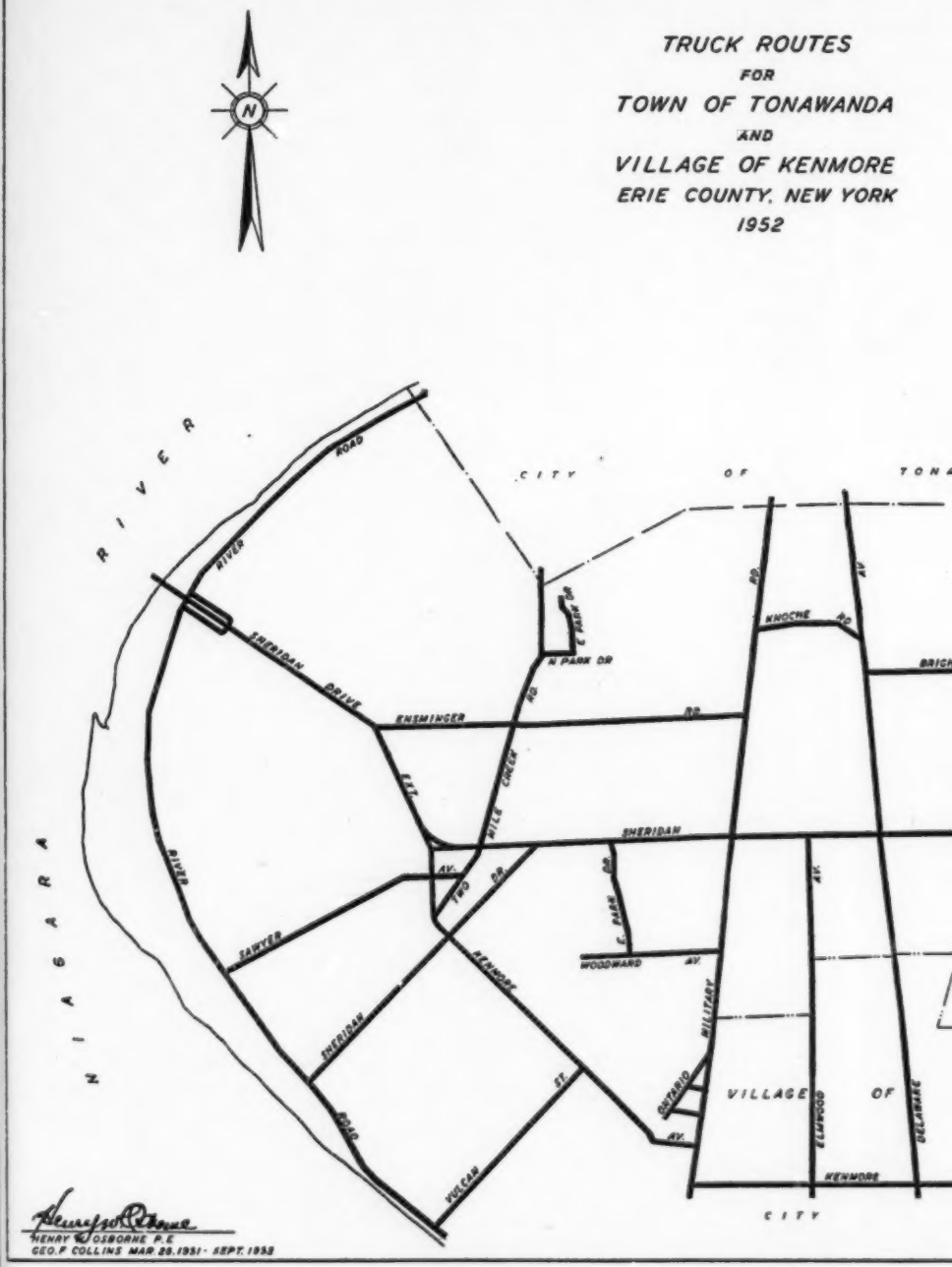
Results of Truck Route System

Adoption of the truck route system gave impetus to a multi-million dollar program of street resurfacing and repairing in Buffalo. Communities adjoining Buffalo were quick to realize the benefit of a truck route system and promptly adopted truck routes of their own which were integrated with Buffalo's. The village of Kenmore and the Town of Tonawanda were the first to act. The City of Lackawanna, the Town of Cheektowaga and the Town of West Seneca which also adjoin Buffalo have indicated intentions to meld truck route systems with Buffalo's.

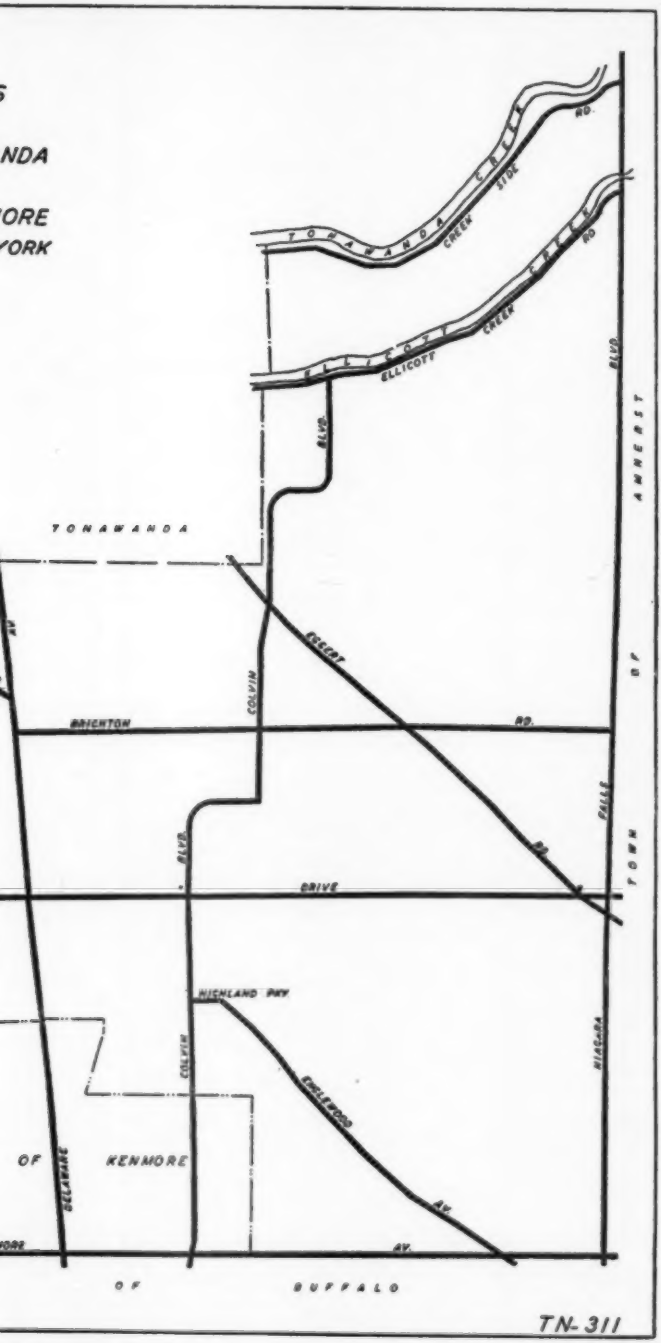
The 1952 ordinance adopted by the Board of Safety to restrict the operation of heavy trucks and commercial vehicles follows:

"Section 40. *Operation of commercial and delivery vehicles and heavy trucks regulated.*

(1) *Parks and thoroughfares prohibited to commercial vehicles.* No person, firm, or corporation shall drive or operate or permit to be driven or operated any trucks or any other vehicles used solely or principally for commercial or delivery purposes, whether loaded or unloaded, into, along, or through the following listed parks, parkways, park approaches and avenues: (17 streets, parks and parkways). The prohibition herein contained shall not be construed to prevent such vehicles crossing said parkways and avenues at



Kenmore and Tonawanda Were First to Follow Buffalo in Adopt



lo in Adopting Truck Routes.

regular street intersections where such vehicles are permitted to operate, nor to prevent the necessary delivery of merchandise or other property to any premises located in or upon any place or thoroughfare above mentioned, provided the vehicle by which any such delivery is made shall enter and leave any such designated thoroughfare by the nearest accessible street to the place where said delivery is made, and provided such delivery vehicles shall remain on said prohibited places and thoroughfares for a period of time no longer than necessary and reasonable to make such delivery or to complete a loading of such vehicle.

A conspicuous and legible sign shall be placed at each entrance to said parks, parkways, park approaches, avenues and places herein designated clearly indicating such restriction.

(2) *Truck routes.* Pursuant to the authority contained in section ninety, subdivision 1–a, of the vehicle and traffic law of the State of New York, the City of Buffalo hereby establishes a system of truck routes.

Any truck having a total combined gross weight of vehicle plus load in excess of five tons shall be excluded from all streets in said city, except from those streets, or parts of streets, hereinafter listed or described which form a part of the system of truck routes upon which trucks are permitted to travel and operate. The total combined gross weight of vehicle plus load shall be ascertained by computing the entire weight of the truck or vehicle plus load, or in the event that said vehicle is a tractor trailer combination, then by computing the entire weight of the tractor and trailer plus load. Such exclusion shall not be construed to prevent the use of an excluded street where necessary for reasonable ingress to or egress from any premises, nor to prevent deliveries or loadings of merchandise or other property or materials along the streets from which trucks are excluded, if accomplished in a manner similar to that described in subdivision (1.) of this section, nor to prevent the necessary operation of trucks while in use by the United States postal or military services, or by fire, police, sanitation or street maintenance services, or by public transportation corporations on franchised routes, or by public service corporations while on emergency repair work.

All streets forming part of such truck route system shall be marked by conspicuous signs bearing the words "truck route" in letters not less than five inches in height, such signs to be spaced not more than 1500 feet apart. In addition, conspicuous signs bearing lettering not less than 5 inches in height, adequately illuminated between sunset and sunrise, or to be constructed of a reflecting material, so as to be easily readable at night when lights from vehicle headlights fall upon such signs, shall be placed on each main highway entering the city, at or near the point where such highway crosses or meets the boundary line of the city, indicating that trucks having a weight in excess of five tons, including load, are excluded from all streets within the city, except those streets designated as part of the authorized truck route system.

No person, firm or corporation shall drive or operate, or cause to be driven

or operated, any excluded truck into, upon, along or through the streets of the city in violation of the provisions of this subdivision.

The following listed streets, or parts of streets as herein designated, shall constitute the system of truck routes in the city:

(127 streets and sections of streets)
See Master Buffalo Truck Route Map

In addition to the above designated system of truck routes, the following described and bounded unrestricted area of the city, and the streets enclosed therein, shall also constitute and be a part of the city's system of truck routes, excepting those streets included in the particular area hereinafter designated as being excluded from said unrestricted area:

(36 descriptions of outside boundaries follow)

The streets, or parts of streets, included within the following described particular area are not to be deemed a part of the system of truck routes and are excluded from the unrestricted area above described, unless otherwise specially so designated in this ordinance:

(9 descriptions of outside boundaries of prohibited areas)

(3) *Operation of automobile transport conveyors limited.* No person, firm or corporation shall operate or permit to be operated, any vehicle commonly known as an automobile transport conveyor designed for carrying automobiles, whether loaded or unloaded, between the hours from 7 A.M. to 12 o'clock midnight daily, except for one block from its loading or unloading point, upon the portions of the streets named below, to wit:

Street	*Prohibited Portion of Street*
Main Street	between Seneca Street and northerly city line.
Delaware Avenue	between Niagara Square and northerly city line.
Washington Street	between Ohio Street and High Street.

Provided, however, that during said prohibited hours, such conveyors when loaded may enter Main street at Michigan avenue and proceed northerly to the City Line for delivery purposes only on Main street, between Michigan avenue and the northerly City Line, and such conveyors may also enter at and proceed northerly on Main street from Michigan avenue to Kensington avenue for delivery purposes only on Bailey avenue.

In evaluating the results, attitudes and actions stemming from operation of the truck route system, it is well to repeat that the plan was effectuated over a three-year period, beginning in the latter part of 1949 and extending to the time it became fully enforceable in

August, 1952. During that three-year period, the truck route system received valuable publicity in the newspapers, the public was informed of every step in the development of the plan, and the trucking industry played a part in its preparation.

Prior to the date it became enforceable, the trucking industry in a cooperative spirit put the plan into effect itself, instructing drivers to adhere as much as possible to the designated truck route streets. Thus, when the signs were posted and the system became enforceable, no great change was noticeable—the system already was 90 percent effective. There was no sudden transformation in trucking operations, no abrupt switch of truck traffic from the forbidden streets to the permissive streets. The reaction of truckers and the public therefore has been good.

A subsequent effort by truckers tried to get relief from the five-ton limitation on off-route streets. They want the limit raised to nine tons. However, officials generally feel this would completely defeat what the city set out to accomplish.

Since last August, a few isolated instances have occurred where small industries in principally-residential sections found it difficult to avoid the residential part of the street on which their plants are located. One case ended up in city court after the residents protested, but it was dismissed because the signs had just been posted. Studies indicate that the answer to this problem might be to add branches to the truck route system to include these partly-residential streets.

One change made since the system was first enforced was elimination of three comparatively short residential streets and substitution of reasonable alternate routes nearby. This change had no material effect on the over-all system.

Another situation that came to light involved a long cross-town artery which begins in a highly industrialized section of the city, passes through a first-class residential area and ends in a second-class residential section. An effort was made to eliminate that part of the street running through the first-class residential section from the truck route by designating it a parkway. The Board of Safety found there was no alternate route within a reasonable distance and rejected the proposal on the ground that truck traffic in that street is essential and must be maintained.

In a few other cases it was necessary to post signs notifying truck drivers that heavy trucks are excluded from certain residential streets where drivers inadvertently swung from truck route streets into these important traffic carriers.

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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